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Aſtronomia Accurata;

OR THE

ROYAL ASTRONOMER and NAVIGATOR.

CONTAINING NEW IMPROVEMENTS IN

Aſtronomy, Chronology, *and* Navigation.

PARTICULARLY

New and correct SOLAR and LUNAR TABLES;
With PRECEPTS and EXAMPLES of their USE, according to Old or New STYLE.

The ELEMENTS of the *Radical* Mean *Places* and *Motions* of the PLANETS and SATELLITES.

A *New* and *Correct* CATALOGUE of STARS.

With their *Right Aſcenſions, Declinations,* and *Annual Variations,* (ſupplying the Place of URANOGRAPHIA BRITANNICA.)

And ANSWERS to *Fifty-three Aſtronomical* QUESTIONS.


J. Wale inv. et del. *J. S. Müller Sc.*

CHRONOLOGICAL RULES and TABLES.

REDUCTION of the DATES of ÆRAS.

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AND

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An *alphabetical* TIDE-TABLE: An univerſal SEA-COAST TABLE, of the *Latitudes* and *Longitudes* from *Greenwich,* and alſo the Iſland of *Ferro,* of the moſt *remarkable* Sea-Coaſt *Places, Ports,* and *Harbours,* lying *contiguous* round the WORLD.

To which are added

An *explanatory* COMMENT on the MOON'S *Theory*: An *eaſy* Method, with *Examples,* of *computing* the LUNATIONS, and of *Solar* and *Lunar* ECLIPSES. And *how* to determine the *Difference* of LONGITUDE, from the *Royal* Obſervatory, at *Greenwich,* by obſerving the *Moon's Place,* under any *diſtant Meridian.*
With *ſome* uſeful *Remarks* and *Improvements* on the Motion and Theory of COMETS.
The *whole* interſperſed with a Variety of *neceſſary* Tables, and *Articles,* ſubſervient to the *three* principal SUBJECTS.

By ROBERT HEATH, a *Military* OFFICER.

Now Heav'n in all her Glory *ſhone, and roll'd*
Her Motions, as the Great FIRST MOVER'S *Hand*
Firſt wheel'd their Courſe. ———— Milton's Par. Loſt. B. VIII. L. 499.

LONDON: Printed for the AUTHOR. *Price* . in Sheets. M.DCC.LX.

☞ Thoſe *Books* not having the *Copper-Plate* of the *Palladium (Time* and *Minerva)* affixed to the *Title,* or *Frontiſpiece,* and ſigned with the *Author's* own Hand, and ſealed with his Seal, *(a Coat of Arms, and* Lion *rampant)* or any with the Frontiſpiece-ſpace left *Blank,* are *ſpurious, counterfeit, pilfer'd,* or *pirated.* And a handſome *Reward* is hereby offered to any *Perſon* who ſhall be pleaſed to diſcover to the *Author* any ſuch Books, publiſhed, or diſtributed, againſt his Knowledge or Conſent. — All Purchaſers whatſoever may be ſupplied at Mr. *Cole's, Mathematical Inſtrument-maker,* in *Fleetſtreet, London,* Succeſſor to the eminent Mr. *Wright,* with proper Allowance of *Seven* for the Price of *Six* Books, to all Bookſellers and their Country Correſpondents. Where *only* the *Trade,* in Town, may be ſupplied at the *proper Prices,* for *ready Money,* with Allowance of the *Quarter-of-Hundred Book,* beſides the Seven for Six Books, taken together; by thoſe Gentlemen ſigning their *Order* and *Place* of Abode; or ſubſcribing for what Number they pleaſe.

TO THE

HONOURABLE and REVEREND

SPENCER COWPER, D.D.

DEAN of *DURHAM.*

SIR,

HOW illuſtrious *and* ennobled *is* SCIENCE! *when Perſons of* high Birth, Honour, *and* Diſtinction, *become her* Votaries, *and worſhip at her* Altar; *while other humble Admirers are obliged to have Recourſe to the* Favour *and* Intereſt *of their* SUPERIORS *to be admitted to her* Smiles!

Had not you, Sir, *vouchſafed me the* Honour *to compoſe the* Comment *on the* lunar Theory, *to* model *the lunar* Equation-Tables, *and to lend me your* Aid, *in bringing the* ROYAL ASTRONOMER *to Light, that* uſeful Deſign *muſt have ſtill lain dormant in* Oblivion: *Which being matured by your* actuating Genius, *naturally ſeeks your* Patronage *and* Protection.

The incomparable Sir ISAAC NEWTON *laid the Foundation of a perfect* lunar Theory *and* Computation, *and pointed out the Means to his* indefatigable *Succeſſors for accompliſhing ſo deſireable an Attainment; to which the illuſtrious* Halley, *of our own Nation, the celebrated* Mayer, *M.* De la Caille, *and other* ingenious *Foreigners, have amazingly contributed. But you are the* firſt Engliſhman *who ſo* eaſily *reſolved the* difficult CENTRAL EQUATION OF THE MOON, *in* two Parts, *and introduced ſuch other* new *and* eaſy lunar EQUATIONS, *deduced from the* Newtonian *Principles of Gravity, as have, at the greateſt* Difference, *rendered the* final Computation *of the* Moon *within* two Minutes *of* Truth; *which the great* Newton *himſelf left at a* Difference *of* above five Minutes, *and* Halley's *Computation left at above* eight *Minutes; as appears by his obſerved and computed* lunar Places, *compared for a* Plinian *Period of* 18 *Years; in the* noble *(and before unequalled)* Correction *he has given us of the* lunar Theory. *But your Computation, at a* mean Difference *from* Truth, *is not above* three Fourths *of a* Minute; *as appears by your* Table *of* one Hundred lunar Places *computed. Which great* Accuracy *is ſhewn, in the* following Work, *to be of* prodigious Advantage in obſerving the Longitude from *Greenwich* Obſervatory, in long Voyages, at Sea.

The celebrated Mayer *of* Gottingen, *undertook the* arduous Taſk *of correcting the* lunar Theory *about the ſame Time with yourſelf. You have ſince* adopted *his* conciſe Method *of Computation in the* Conſtruction *of your* Equation Tables, *and ſo far improved upon it, as to perform that, with* equal *Accuracy, by* ten *eaſy* lunar *Equations, and one correcting Table, which that* celebrated Foreigner *has conſtructed* thirteen *different Equations, and as* many *different Arguments, to perform. And as you have as* uſefully *and* elegantly *improved and adorned the* lunar Theory *and* Computation, *you are, among other celebrated Improvers of the* cœleſtial Science, *(of which* KINGS *and* PRINCES *have been* Patrons *and* Promoters) *juſtly entitled to your* merited Honours!

Your great Example, Sir, *in encouraging and improving* Science, *will not only do* Service, *but redound* Honour *to this Nation. And, as your* Motive, *in your indefatigable* Purſuit *of* new Acquiſitions *in Aſtronomy, appears to be the* public Utility *more than a View to your own* Reputation, *your* excellent Improvements *will reflect* Honour, *as long as the* SUN *gives, and the* MOON *reflects,* Light.

But

But it will not seem strange *to those who are the* least *acquainted with your* NOBLE FAMILY, *and your* Affection *for the* belles Lettres, *(which you seem to inherit as much by Nature as Acquisition) that you are a* Lover *and* Promoter *of the* LIBERAL ARTS.

The noble Earl the LORD CHANCELLOR, *your* FATHER, *was the Ornament of the Age in which he lived. His manly* Ciceronian *Eloquence, in debating the weighty Affairs of State; his* Patriot *Zeal, for the Liberties and Constitution of his Country, when attacked by perfidious and implacable Enemies; his uncorrupted* Fidelity, *in the Discharge of* Offices *of the highest Trust; his indefatigable Labours, in the Discovery of* Truth; *and unbiassed Integrity, in the Administration of public* Justice; *are so many* Monuments *of the Greatness of his Mind, the Honesty of his Heart, his vast Capacity, and unexampled Worth. The* Rebel Lords, *on whom he, as* Lord High Steward, *pronounced Sentence of Death, were no less edified and convicted by the Force of his Reasoning, than they were instructed to embrace their* Fate *with a becoming Resignation.*

But you, Sir, *were not educated to* adorn *the Profession in which that great Man,* your Father, *was early and eminently distinguished, but you were* destined *to improve the* COELESTIAL SCIENCE, *and to instruct Mankind in the Knowledge of their* true Happiness; *to encounter* Vice, *and reform an* immoral *Age, by the* benevolent *Spirit of* CHRISTIANITY. *Wherein the Dignity of your* Birth *and noble* Alliance, *(being Brother to an* Earl *and married to the Daughter of a late noble* Lord) *are of Advantage to the* Doctrines *you inculcate; in making the greater* Impression *on the Minds of your* Auditors.

But I must intreat your Pardon, *Sir, for having thus far trespassed on your Patience; occasioned by the* Dignity *and* Lustre *of the Subject, as well as by the* Respect *and* Gratitude *I owe you, for the* singular *Obligations and Honours I have frequently received at your Hands.*

Who am, with the highest Regard,

SIR,

Your most devoted,

Most obedient,

Upnor-Castle, September 29, 1760.

and most humble Servant,

ROBERT HEATH.

PREFACE.

PREFACE.

AFTER long Expectation, we have publiſhed our *Aſtronomical Tables* of the *Sun* and *Moon*; which being connected with the Subjects of *Chronology* and *Navigation*, we are obliged, on Account of the Alteration and Enlargement of our *original Plan* and *Deſign*, to omit our Aſtronomy of the *Planets* and *Satellites*; referring our Reader to our *Aſtronomia Perfecta*, or Supplemental *Aſtronomer and Navigator*, for Satisfaction in thoſe Subjects, and in all others promiſed and expected, to complete our *Undertaking*. Which *Work* will be printed as ſoon as due Encouragement is given us; but without proper Encouragement (as all Subſcribers may, *conditionally*, depend on our Honour of ſtrictly fulfilling our Engagement) no ſuch *Work* will be printed, ſolely, at our own Hazard of Expence; though great Part of the Copy is *actually* finiſhed.

To get the correct mean *Places* and *Motions* of the *Planets* and *Satellites* (employing the utmoſt Skill and Induſtry of the *ableſt* Aſtronomers, for many Years, ſince the Improvement of *accurate* Inſtruments to obſerve them) is *no eaſy* Attainment. But to ſettle the *Variation* of theſe ſeveral Motions, by an Acceleration, and determine the *Forms* and *Equations* of the ſeveral *Orbits*, ſo that the *computed Places* may correſpond nearly with the Places *obſerved*, for the preſent *Century* and remote Ages, is a Taſk requiring the *greateſt* Judgment and Aſſiduity to perform. In which we have not wanted *proper* Aſſiſtance from our *ableſt mathematical Aſtronomers*, and for perfecting which we are beholden to *foreign* Obſervations more than thoſe made at *Home*, the more difficult to acquire; and not obtainable at all but by the deepeſt *Artifice*. One *Britiſh Obſervator* brooded, like a *Miſer*, over his *Obſervations*, depriving this Nation, as 'tis ſaid, of a perfect *lunar Theory*, by ſecreting ſome, and falſifying other, of his Obſervations, ordered Sir *Iſaac Newton*; inſtead of being uſefully and generouſly communicable of his *Diſcoveries*, like the late SCIENTIFIC and ILLUSTRIOUS HALLEY!

As to what is pretended of the Diſcoveries of the INDEFATIGABLE and ACCURATE Dr. BRADLEY, neither the Motion of the *Earth's Aphelion* (could it be exactly known) the *Aberration* of the Light of the *fixed Stars*, nor the Equation of the *Preceſſion* of the equinoctial Points, nor that of the *Nutation* of the Earth's *Axis*, (all but imperfectly known, though pretended of ſuch Importance by the great *Halley*'s Preface Writer) are ſufficient to account for the ſeveral *Variations*, in the planetary Orbits, where the computed Errors, in each, partly depend on thoſe of the Earth's Orbit. And had the late Mr. *Flamſtead* been acquainted with all theſe refined *Matters*, as we are at preſent, they, probably, would not have reconciled the apparent *Errors* in his Obſervations.

The celebrated *Halley*'s Skill and Contrivance, in ſupplying the *Defects* of the *lunar Equations*, by a Correction of *Errors* of the lunar Computation for a *Plinian* Period, as recurring, after which, of the ſame Magnitude, are no leſs to be admired for the Invention thereof, than for the *Utility* and Importance of the Improvement. Which Method can only be exceeded by ſome ſuch *direct* Correction of the *lunar* Theory and *Computation*, as in our TABLES is attempted.

As to what is given us for *Halley's Computation*, by his Precept-Writer, ſeems to carry a Miſtake. For otherwiſe, what Reaſon can be aſſigned for the *ſagacious Halley* placing the *Fourth* (or *Newton*'s 6th) *before* the central Equation; if, as the Precept-Writer repreſents, it was deſigned to be uſed after the central Equation. Uſing it before requires an aukward Correction of its Argument; without which Correction he pretends there will come out near *half a Minute Difference*, more or leſs, in the Error of *Halley's Abacus* of computed and obſerved Places, compared in his TABULÆ *Lunæ Meridianæ*. Whereas if this fourth Equation were deſigned by *Halley* to be uſed after the *central* Equation, it had been *properly* and naturally placed after it, immediately before his *Variation Equation*; whereby the preſent troubleſome Correction of its Argument, and confounding the *Computer* how this Equation ſhould be uſed, had been *avoided*. But this Precept Writer *palpably* miſtakes, *(in p.* A. 8. *Halley's Tables) where he applies the Exceſs of the Sun's Equation, and Sum of the Moon's Equations* (reduced to Time in Mean Motion of the Moon from the Sun) *to the Time of the Mean for that of the True Syzygy*; without conſidering *the Sign of the greater Quantity, in the ſaid Exceſs*; *and therefore miſtakes, in his Account of the* true *Syzygy preceding the Mean, or the Mean preceding the True: Which intirely depend on the* Negative *or* Affirmative *Sign of the* Sum *of the Sun's Equation with its* proper *Sign, and of the Moon's Equations with a* contrary *Sign*; *which Sum, with its proper Sign, is univerſally the Equation of the* Interval *between the Mean and True* Syzygy, *and not as* Halley's *Precept Writer deſcribes.*

We have given, what was much wanted, the correcteſt *Catalogue* of eminent fixed Stars of any extant, from M. *De la Caille*'s Obſervations, with their Right *Aſcenſions*, *Declinations*, and *annual* Variations; by which the Moon's Right *Aſcenſion* or *Place* on the Meridian, or at other Times, may be readily determined; as alſo the Right Aſcenſion or Place of a *Planet* or *Comet*, at any Time, moving in its Orbit. This *correct Catalogue*, ſo far as it extends, may be ſaid to *more* than ſupply the Place of the once promiſed and expected *Uranographia Britannica*. And it were to be wiſhed, for the Honour of this Nation, that we had a *Britannic Catalogue* publiſhed, of all the moſt faithful, diligent, and correct Obſervations of the *fixed Stars*, that have been made by our moſt able and *celebrated Aſtronomers*. Since it is a Matter of high Importance to this Nation, that *all the Obſervations* made at the *Royal Obſervatory* at *Greenwich*, ſhould be publiſhed at certain Times, for the Correction of our *Theories*, and Improvement of *Aſtronomy*; on which our *Navigation* ſo much depends.

PREFACE.

In the Preface to *Halley's Tables*, it is remarked, by his *Preface-Writer*, "*That the Publication of* astronomical Ob-
"servations *is of very great* Importance, *as they never become* obsolete *like* Tables; *but, on the contrary, the Usefulness of such Observations as are carefully made and faithfully delivered is greatly enhanced by their* Antiquity. *That the more diligent an* Observer *is, the more is the Public concerned in the* Preservation (and he might have said *Publication) of his Labours, and the* less *suitable is the Expence*" (of such Publication) "*to the* Circumstances *of a private Person.*"—Yet we find that no *British* Observator, since the communicative *Halley*, has followed the *Example* of the above *Precept*; though the *Precept-Writer* has invidiously spoken of that great *Astronomer* and *Mathematician* in another Part of his Preface, as not having published his *Observations*. Whose *Pretence*, that the *Greenwich*-Observations are best printed at the public Expence, "*as less suitable to the Expence of a private Person*" (while the *Palladium* Author, or any other Promoter of Science, would print them, were they open to Access) seems calculated for a *prudent* Augmentation of the present *Salary*, or else is proposed for a *Perquisite* to some Favourite *Assistant-Observer*.

As to communicating to the *Ladies*, the Method of making *cælestial* Observations, from *Greenwich-Hill*, shewing them the rising Moon, and other *Objects* of Pleasure and Improvement, from that delightful View, we greatly approve. And we wish, those *Ladies*, vainly attending on the ORACLE in the *Old Bailey, London*, to consult their *Destinies*, and other future *Events*, would henceforth, *more wisely*, attend the *cælestial* Observators; it being not above an Hour's Travel further, in their Coaches, to have infallible Proof of the *secret* Transactions among all the *bright Rulers* in the Heavens! There they may see the celebrated Mr. *Gael Morris*, enamoured of the *Goddess of Science*, walking Hand in Hand, and the renowned Mr. *T. S.* F. R. S. *Usurper* of the *Ladies Diary*, holding up her *Train!*

The Change of *Declination* of the *fixed Stars*, according to Succession of Years, happening with the Variation of the *Ecliptic Obliquity*, or Distance of the Pole of the Ecliptic from the Pole of the World, is no more to be wondered at than their *annual* Progression in the Signs of the *Ecliptic*, by the *Precession* of the equinoctial Points. By which Means, the Distances of the *fixed Stars* are found to increase, or decrease, from the *Vertex* of any Place, according to their *annual Variations*, as seen in our Catalogue. So that the Variation of the Declination of the *polar Star*, and of all other Stars, inserted in our Catalogue, for any Number of Years, past or to come, and thence the present Declination of a given Star, may be readily and truly determined.

Our *supplemental* EQUATION-TABLES, in the present *Work*, used with the *Eccentricity* of the Moon's Orbit, and *second Equation* of the Moon's *Apogee*, are designed for making Trial and Improvement of Computation, by the different Kind and Number of *lunar* Equations to be used. *Mayer*'s lunar Equations are inserted for the same *Purpose*; to compare their *Result* with that from the *lunar* Equations marked C; and also with the Result from our other Equations.

The *Rest* of our *Work* we leave to speak for itself, or the Critics for it. On which we observe, that we shall be so far from taking it *amiss* from the *judicious* Critics, that we shall be obliged to them to mark our *Defects*, for the Improvement of Truth and Science. But if *Cavillers*, instead of *Critics*, should presume to find *Fault* with what they do not understand, or, according to the Custom of some Monthly *Reviewers*, use Contempt, Derision, and Abuse, for Criticism, on Subjects they are not Masters of, we shall have Recourse to *Words* with the *Publisher*, in our Vindication, unless he delivers up his *Emissaries*; as all such *Scoffers*, and *Pretenders* to Science, are very easily answered in their own Way; being no more than so many *Flies* under the Brush of a *Flapper*, — one being now sick of a *Sarcasm* —— another *maimed* by a Stroke of *Ridicule*; —— and a *third* disabled by a *Strain* given to his *Attention*, &c ——Some have ventured, without *Ideas* on the Subject, to characterize Mr. *Emerson*'s Treatises of *Fluxions*, *Mechanics*, &c. and some to *criticise* and *correct Newton*'s *Principia*; but alas! how vain and insignificant must all these *Pretenders* to Criticism appear, when it is considered that they attempt to criticise such unequalled Productions; of which Subjects we have but very few Persons, in this Nation, (now appearing) *eminently* qualified to judge. Who then, but Men of equal *Genius* and *Capacity*, shall be able to judge of the difficult yet certain Truths and Demonstrations those few Persons of Ability write? It is true their *Method*, or *Language*, may be cavilled at, to which all Method and Language are liable; but this is Nothing to the Truth of their *Conclusions*, deduced from a *Series*, or Chain, of demonstrative mathematical Arguments; whose right or wrong Inferences are the principal Part of the Subject to be criticised. And though many *speculative* Truths are not reducible to Practice, yet the *Demonstrations* of those Truths, on assumed Principles, are not the less certain; as will be found, where the Critic has *Ideas* and Judgment to pursue the intricate Chain of Reasoning. ——— Nevertheless there are many *speculative* Truths that are not necessary to be introduced in Practice; such as building Bridges on *circular* Arches instead of on elliptic or other Arches, full as sufficient, as circular Arches, to answer the End proposed, and to last out the *Materials*: Which Truth is in the Province of the practical *Engineer*, more than with the speculative *Mathematician*. There are other *speculative* Truths, in Astronomy, not reducible to Observation; as we find in the *Miscellaneous Tracts*. — And we hereby advertise the *judicious* Critics, that we are sensible of the Breaches of Connexion and Method in our *Work*, in our *promiscuous* Way of writing it, while the *Press* was employed; which will be all rectified in our *second Edition*: TRUTH (which we have endeavoured to preserve through the whole) being our principal OBJECT!

Our *Royal Astronomer* was not begun on the *Plan* whereby it is now finished. It was *originally* designed to contain only a few *solar* and *lunar* Tables, for accurately computing the Sun and Moon's *true Places*, to *vie* with, and make Improvement on, the *Plan* and Method of the *celebrated Mayer*'s Tables. But finding this *Accuracy* of Computation would not have *its Use* unless applied to *Navigation*, (in observing the *Moon*'s Place under a distant Meridian, for determining the Difference of *Longitude*, at Sea, by the Difference of that Time, and the Time when the Moon has the same computed Place at *Greenwich*, by our *Tables*) we farther extended our *Plan*, to the Royal *Astronomer* and *Navigator*. To which we found, that *Chronology*, and some other subservient Subjects being added, would render the

a *Work*

Work still the more useful and acceptable to the Public. But, in this progressive Augmentation, our Encouragement from Subscribers, we are sorry to say, was *not proportionable* to our Endeavours to oblige; and we find but few Encouragers of Science in this Kingdom.

Mr. *Emerson*, in his Preface to his *Mechanics*, observes to the following Purpose. — *That no* Mæcenas, *in this Age, appears to patronize and protect Science; that the Decline of Arts and Science* (he thinks) *is in a great Measure owing to the false Ambition and extreme Avarice of the present Age. Where Men* (unlike the *antient* Sons of Science and Encouragers of Arts and Literature) *not being able to lift their Eyes above this Earth, make Nothing so much their Care as raking together the Dross it affords; striving, like the Mole, who shall die with the most Earth in his Possession.* (Where some find more Plague to take Care of their *Abundance*, than others to supply their *natural Wants.*) *That natural Knowledge finds Nothing but Contempt; and that* Minerva *yields to* Pluto. *That, if the general Disposition of Mankind had been in all Ages, as in the present,* he doubts, *whether we should have had either a* Mill *to grind Corn for our Bread; or a* Pump *to draw us Water. That, it is a* trifling Excuse *for Men in exalted Station to plead their Unacquaintance with Science; since Learning, of all Sorts, has been ever deemed under the Care and Superintendency of the* GREAT: Who ought to *protect and encourage Science and its Professors, for the Promotion of public Good. That Friendship and Generosity among the Great are hard to be found.*

Scire volunt omnes, mercedem solvere nemo.
Juv.

And the Reason the World has so few Aristotles *is because there are so few* Alexanders.

And we have observed, that invented *Histories*, corrupt *Novels*, and other *false* Amusements, find much more Encouragement than a Treatise on real and useful Knowledge.

But, that we may account to our *worthy Subscribers and Encouragers of Science* for the *extreme Delay* in the Delivery of our present *Work*, besides the Time required to *select, vary,* and *new model* our several Materials, the most for Advantage in our extended *Plan*, the Nature of Printing the Work has been such, and the Time required to convey and correct the Proofs, that, on Account of these several unexpected Hindrances, it could not be executed and delivered sooner. —— And we hope that our Subscribers will excuse us (having shared in their respective Uneasiness) for these unforeseen Occasions of Delay.

☞ *To prevent all such Uneasiness and Disappointment, on all Sides for the future, we have provided sufficient Means of Dispatch, for printing our* second Edition; *also our* Supplemental Astronomer and Navigator, &c. *as soon, as future Subscribers shall be pleased sufficiently to encourage those separate Works, on the Terms proposed in our* Palladium *for the Year* 1761.

TO *the* ENCOURAGERS *and* IMPROVERS *of* ARTS *and* SCIENCES.

Vincit Amor Patriæ. ——
Virg. Æn. VI. v. 823.

WHATE'ER in *Egypt*, *Greece*, or *Rome* was known,
England can boast a GENIUS of her own;
Who, form'd with *Passions* Science to befriend,
And vers'd in *Arts*, Encouragement shall lend.
While the *less noble* stoop to *abject Ways*,
His *Works* a lasting *Monument* shall raise!
His *Principles* — as noble as his *Blood* —
Who acts in private for the *public Good* —
Descended from a *loyal* Patriot-Race,
Whom *Trust* still honours, and *no Arts* debase;
To *Statesmen*, *Heroes*, *Gen'rals*, allied,
Their PRINCE's Glory, and the Nation's Pride!
In *Fame*'s imperial Temple highly plac'd,
And *some* with laurel'd Honours doubly grac'd —
O *Sons of Science*, Merit still pursue,
And, by *Example*, keep the *Prize* in View;
Exert your *Talents* still to bless Mankind,
And a *Reward* your *Services* shall find;
Though Loss of *sacred Science* is deplor'd,
That *Treasure* in a COWPER is restor'd!

R. HEATH.

The

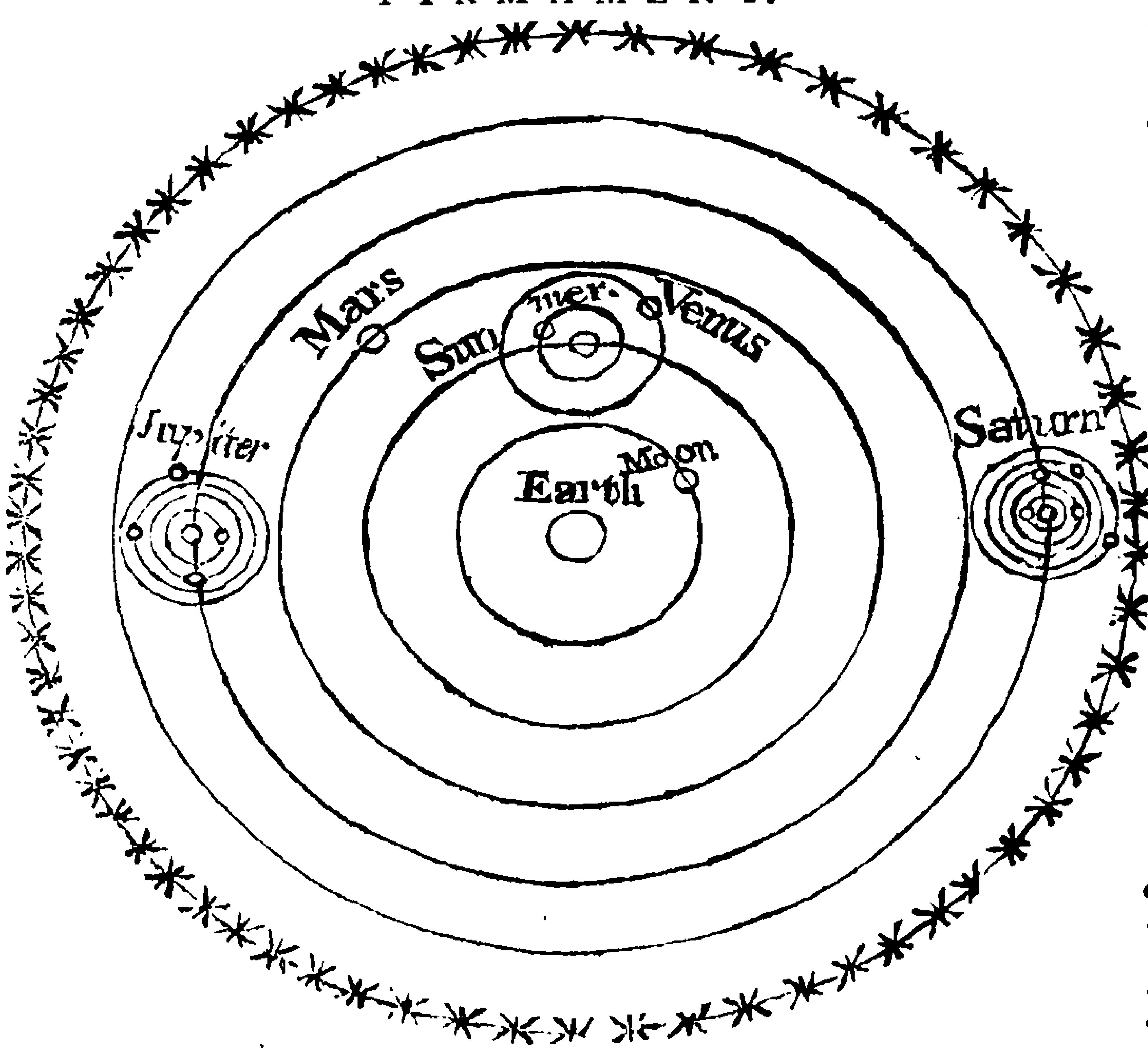
The NEW *absurd* SYSTEM, *lately published in* Latin, (in the *Imp. Magazine, September* 1760) *for the true* SYSTEM *of the* WORLD. *By* F. B.

THE true *System* of the World is not that of *Ptolemy*, so much to be admired for its harmonious *Epicycles*, nor that of *Copernicus*, so famous for explaining the several *Phænomena*; nor yet that of *Tycho*, representing a noble, and, as it were, a *Gothic*, Structure. Among the Ancients, *Ecphantus* the *Pythagorean*, and *Heraclides* of *Pontus*; among the Moderns, *Origanus*, and *Longomontanus* were not unacquainted with this *System*. But I find none, in our Age, but *William Comins*, an *Englishman*, *Vicar* of *Uffenden*, in *Rutlandshire*, who has writ Something in Favour of this *System*. *Plato*, after he had begun to make a Figure in Philosophy, was pleased with it: I own, indeed, that he afterwards altered his Opinion of it, because the true *Theory* of this System, as one may guess, did not occur to his Thoughts. The whole System is thus explained on Principles consentaneous both to natural Philosophy and Geometry. —— *Crede quod habes, et habes.* ——

" *The Earth is situate in the Center of the World, and revolves round its* Axis *from* West *to* East, *whereby* Light *and* " Darkness *succeed each other daily, and the* Stars *appear to make their daily Revolutions from* East *to* West. *The* Moon *is* " *carried round the* Earth *from* West *to* " East *in the Space of one Month.* Mercury *and* Venus *revolve by a particular* " *Motion about the* Sun; *the former in about* 3 *Months, the latter in about* 7 ½ " *Months, and at the same Time are carried round the Earth, every Year, with* " *the* Sun. Mars, Jupiter, *and* Saturn, " *run through their respective Orbits, (near* " *the Center of which the Earth is* fixed) " *the* first *in* 2 *Years, the* second, *with his* " Satellites, *in* 12 *Years, and the* third, " *or* Saturn, *with his, in* 30. *The* fixed " Stars *are at Rest; whence the* starry " Heaven *is called, in sacred Writ, the* " Firmament.

The New Absurd SYSTEM of the WORLD. By F. B.

FIRMAMENT.



" *The* Stations *and* Retrogradations " *of* Venus *and* Mercury, *in the true* " *System of the World, are in the* Copernican *Hypothesis*; *and in* Tycho's *System are particularly explained*; *but the* " *Stations and Retrogradations, which appear to the Eye in* Mars, Jupiter, *and* " Saturn, *proceed solely from the Circulation of Light from* West *to* East, " *which is greater or less, according as the* " *Planet is in* Apogeon *or* Perigeon, *or at* " *a greater or less Distance from the* " *Earth.*

" *The Manner of this* Circulation *will* " *clearly appear from the following* Example. *If a* Stone *fall from the* Firmament *to the Earth, beside that Motion, by which it is precipitately carried* " *toward the Earth's Center, it must,* " *necessarily, partake of that Motion also,* " *by which all Things are carried from* " West *to* East, *according to the general* LAW *of the World. What we have said of the Stone, is to be understood* " *likewise of the* Globules *or* Atoms *of Light; as all other Things are carried along from* West *to* East, *while they pass* " *from the* lucid *Body to the Earth. And the nearer the* Planet *is to the Earth, the less will be the Circulation of* LIGHT " *from* West *to* East, *when it reaches the Eye. The Circulation of Light toward the* East *in one* Hour, *for Instance, will* " *be less than in* two; *whence the Planets appear to move more* swiftly *or more* slowly, *or to stand in the same Point of the* " *Heaven, or to return toward the* West, *though they do really always continue advancing to the* East."

F. B.

ON which We QUERE. How will the *Comets* shift for themselves, in their regular Orbits; or what Center or *Law* must they obey, in their respective Motions, to correspond with Observation, according to the above *confused*, or absurdly conceived, *System*? And how consistent this System with the Harmony of a Multitude of *Systems*, each having a *fixed Star*, or new Sun, for its *Center*? And how will *all* the Planets, according to this new *Hypothesis*, describe equal *Areas* in equal Times, about the *Sun*, as observed in the *Copernican* System.

CONFUTATION *of the foregoing* SYSTEM.

Magna est Veritas, et prevalebit. —

Observation 1. The *Squares* of the *periodical* Times are observed to be as the *Cubes* of the mean Distances from the Sun, of all Bodies revolving round the *Sun*; considered as the Fountain of *Light* and *Heat*, irradiated through the whole *Copernican* System: Which *universal Law* observed, is, at once, destroyed, if the Earth is considered at *Rest*. Therefore *F. B.*'s *System* is *absurd*.

2. The Times now observed of the *Conjunctions*, *Oppositions*, and *Retrogradations* of the Planets, are not such as would be, if they revolved, in Orbits, round the Earth at *Rest*.

3. The Bodies of *Mercury* and *Venus* in the lower Conjunction with the Sun, are hid behind the Sun's Body; and in the upper Conjunction, (in the *Copernican* System) are seen to pass over the Sun's Body, in Form of a *dark round Spot*, which is impossible to happen with the Earth at Rest.

4. *Mercury* and *Venus* are observed to have two Conjunctions with the Sun, but no Opposition; which cannot happen unless those Orbits are within the Earth's Orbit. And therefore cannot happen in *F. B.*'s *System*.

5. The Earth being at *Rest*, in the Center of *F. B.*'s *System*, will not account for the different *Brightness* and *apparent* Diameters of the *planetary* Bodies. *Venus*'s apparent Diameter, when *greatest*, is nearly 66′; but when *least* not above 9′ ½. *Mars*'s apparent Diameter, when greatest is about 21′; but when least not above 2′ ½; which *F. B.*'s *System*, with the Earth at *Rest*, will not account for.

6. The greatest *Elongation* or Distance of *Mercury* from the Sun is about 28 Degrees, and that of *Venus* about 47 Degrees, answering exactly to the *Copernican* System; but cannot agree with *F. B.*'s *System*, with the Earth at *Rest*.

7. *Mars*, *Jupiter*, and *Saturn*, have each their Conjunctions and Oppositions to the Sun *alternate* and *successive*; which cannot happen in *F B.*'s *System*.

8. The Earth being placed in the Center of *F. B.*'s *System*, with the Sun and Planets revolving round it, the Planets must then, like the *Comets* in the *Copernican* System, be scorched with Heat, when *nearest* to the Sun; and frozen with Cold, at their greatest Distances; contrary to the Harmony of the *Copernican* System; proving *F. B*'s System absurd.

⁂ *Men of Ignorance and Ostentation endeavouring to raise Doubts and absurd Opinion, concerning settled and demonstrative Knowledge, founded on Experiment and Observation, are Enemies to Truth, useful Science, and the Public.* Newtoniensis.

☞ *The Dates of the* Eclipses *in the* Palladium *for* 1761, *subservient to this Work, are all according to New Style, since the* Gregorian Æra *commenced,* October 5, 1582.

REMARKS *on the said* SYSTEM. *By our ingenious and learned* Correspondent, ARGUS BRIAREUS. (See *Palladium* for 1761, P. 76.)

Clariùs è tenebris depressa resurgit veritas.

THE preceding System, according to my View of it, makes a very *absurd* and *irrational* Appearance, more likely to be rejected, than received as Truth, by the Astronomers of this Age.

The Author whereof would do well to assign a Reason, why the Earth should be *fixed* in the Center of the whole System, rather than one of the other Planets. To say that it contains on it more noble Creatures, Beings of more exalted Faculties and Perfections, and therefore is the most *illustrious* of them all, would be a bold Assertion, and strongly favouring of a Mind overmuch attached to this *little* Ball, and its Inhabitants. And yet, if this be not allowed a substantial Reason, I presume it will be hard to find another that is so. —— It may be asked, why the *Sun* should revolve round the Earth and not rather round one of the other superior or inferior Planets; seeing he is allowed to be the great Source of *Light* and *Heat* to all those dark Bodies. And also, why the Sun be made the Center of the Orbits of *Venus* and *Mercury*, while the larger and superior Planets, *Mars*, *Jupiter*, and *Saturn*, perform their Revolutions round an inferior Planet, the *Earth*, as their Center. Clear, rational *Answers* to these *Questions* may go a good Way to remove Objections to this *System*. If the Answer be made, that these Things must necessarily be so, to agree with the Appearances of the planetary Bodies, it will follow that this System cannot agree with Appearances; though the present *Copernican System* fully and clearly solves all those Appearances. The *Copernican* or *Pythagorean Hypothesis* not only effectually answers that End, in agreeing with the *most accurate* Observations, which the absurd System does not; but is infinitely more simple, uniform, and harmonious in its Construction, and consequently is infinitely more worthy the Wisdom and Contrivance of the divine and matchless *Architect*.

Burfordiæ, Cal. Nov. 1760. ARGUS BRIAREUS.

EXPLANATION of TERMS.

A.

Acherner. A bright Star of the 1st Magnitude in *Eridanus*; observed by Dr. *Halley* at St. *Helena*, in 1677; never rising at *Greenwich*.

Achronical Rising and Setting of the Stars. When they rise in the Eastern Horizon, in the Evening, as the Sun sets; and set in the Western Horizon, in the Evening, with the Sun.

Æras. Points of Time; whence Chronologers begin to compute their Years. Of which Accounts of Time there are many Kinds; as the Æra of Creation; the *Christian*, *Turkish*, &c. Æra; some more famous than others.

Aldebaran.

EXPLANATION of TERMS.

Aldebaran. An *Arabic* Name for a *fixed Star* of the 1st Magnitude, called the Bull's South Eye.
Algenib. A Star of the 2d Magnitude, in the right Side of *Perseus.*
Algol. A Star of the 3d Magnitude in the right Side of *Perseus,* called *Medusa*'s Head.
Allioth. A Star in the Tail of the great Bear.
Almanac. A Succession of all the Week-days, Month-days, and Holydays, correspondent, throughout the Year: Nothing without those Requisites being *truly* and *literally* an Almanac. Which fixed, and not variable or astronomic Computations, are its chief Properties.
Alramech. The same as *Arcturus.*
Amplitude. An Arch of the Horizon between the Rising or Setting of the *Sun, Moon,* or *Star,* and the East or West Points, of the same Name (N. or S.) with their Declination.
Analemma. A Projection of the Sphere, *orthographically,* on the Plane of the Meridian, the Eye being at an *infinite Distance,* placed in a Line perpendicular to the Middle of the said Plane.
Analogy. The same as Proportion.
Angle of Direction. The Angle made by the *Axis* of the Moon's Orbit and *Axis* of the Earth, at the Center of the Earth's Disk. Of great Use in constructing *solar* Eclipses. In which Projection, if

$$\text{Sun in } \left\{\begin{array}{l}\text{♋, ♌, ♍, ♎, ♏, ♐,}\\ \text{♑, ♒, ♓, ♈, ♉, ♊,}\end{array}\right\} \text{ Earth's } \textit{Axis} \text{ to the } \left\{\begin{array}{l}\text{Right}\\ \text{Left}\end{array}\right\} \text{ of the } \textit{Axis} \text{ of the Ecliptic.}$$

Angle of Evection. The Difference between the mean and true central Equation of the Moon, in the *new Astronomy,* the greatest Evection Angle being about 1° 20′ in Quadrature. Or the Difference between the least and true central Equation, according to *Street*'s Computation; the greatest Angle of Evection, this Way of computing being about 2° 37′, in Quadrature.
Angle of Reflection. The same as *Variation* Equation of the Moon; being greatest in *Octants* of the Moon from the Sun, or 37′ 33″, according to *Street*'s Astronomy.
Anomaly. A Planet's angular Distance from the Aphelion Point, or farthest Distance from the Sun.
Anses or *Ansæ.* The Ring of *Saturn*; appearing like Handles to the Body of the Planet.
Antares. A fixed Star of the 1st Magnitude, or the *Scorpion*'s Heart.
Antecedentia. According to a preceding or contrary Order of Signs; the same as *Retrogradation.*
Apsis, or *Apsides.* The Extreme, or Extremes of an Orbit's Transverse Diameter. Signifying also the *Apogeon* and *Perigeon,* of the Moon's Orbit.
Argument of Latitude. The Distance of the Moon from the North or ascending *Node,* in Degrees, &c. by which the Moon's Latitude is determined.
Ascensional Difference. The Difference between the right and oblique Ascension or Descension; or the Time the Sun *rises* and *sets* before and after *Six.*
Ascendent. The rising Point of the Ecliptic.
Azimuths. *Vertical* Circles passing through the *Zenith* and *Nadir*: Which Terms *see.*

B.

Babylon. A famous and antient City in *Egypt.* It stood upon a Square of 120 Furlongs long, of 15 Miles each Way. Circumference 480 Furlongs, or 60 Miles.

$$\textit{Walls} \left\{\begin{array}{l}587 \\ 1350\end{array}\right\} \text{Feet} \left\{\begin{array}{l}\textit{Thick}\\ \textit{High}\end{array}\right. \qquad 480 \ \textit{Furlongs Round}$$

In the Walls were 100 *Gates,* 25 on each Side, with 25 *Streets* each Way, crossing one another at right Angles; making 676 *Squares,* each of which was $4\frac{1}{2}$ Furlongs, on the Side, and $2\frac{1}{4}$ Miles round.
In the *Middle* over *Euphrates,* was a *Bridge* 220 Yards long and 10 broad. The Temple of *Belus* was a Furlong *Square,* consisting of 8 Towers, one above another, each 75 *Feet* high. King *Nebuchadnezzar* enlarged it to 2 *Furlongs* on each Side, making a Mile he enlarged it round. The *old Palace* was 4 Miles in *Circumference*; the *new* 8 Miles. The *Hanging Gardens,* 400 *Feet* Square, by several *Terrasses,* one above another, till the highest became 350 Feet. The *Ascent* was from *Terrass* to *Terrass,* by Stairs of 10 Feet wide, built by Arches upon Arches, and a *Wall* 22 Feet thick. This wonderful City like the famous and antient City of *Troy,* is vanished out of the World, where so many great Things were once transacted! And as magnificent Cities and Empires successively vanish in Oblivion; so shall *Systems* of the *cœlestial* Bodies, and all their Inhabitants, pass away, like *Shakespear*'s baseless Fabrick of a *Vision,* leaving not a *Wreck* behind!

C.

Calendar. The same with *Almanac*: Which see.
Center of the Equant. The same as the upper *Focus* of an Ellipsis, round which the Planets uniformly move.
Conjunction true. When the Centers of two Planets (as of the SUN and MOON) are seen conjoined in a right Line, from the Earth's Center.
Conjunction apparent or visible. When two Planets are seen conjoined in a right Line from the Earth's *Surface.*
Consequentia. According to a following Order of Signs.
Copernicus Nicholas. A Native of *Thorn,* in *Polish Prussia,* born in 1473, and died in 1543. A great Astronomer and Reviver of the *Pythagorean* System.
Cosmical Rising and Setting of Stars. Rising in the Morning with the Sun, and Setting as the Sun rises.
Cycle of the Moon. A Revolution of 19 Years, after which Time the mean *Lunations* return on the same Month-days. The Number of this Cycle is the Golden Number.
Cycle of Indiction. A Revolution of 15 Years, substituted in the Room of the *Greek Olympiads*; denoting the Year the Tribute was to be paid to *Constantine the Great*; established 312 since Christ, on *September* 24.

D.

D.

Day Artificial. *Day of the Sun's Light*, from Sun-rising to Sun-setting: Being the Distinction of Days according to *Custom*, which is the greatest Authority in the proper Use of Words.

Day Natural. *Day of the Year, or 24 Hours.* The Time of an apparent Revolution of the Sun, from any Hour Circle to the same.

Descendent. Setting Point of the Ecliptic.

Digit. The *twelfth* Part of the Sun's Diameter, in solar Eclipses. In *lunar* Eclipses, the Moon's Digits eclipsed may be 23; all above 12 Digits shewing how much the Earth's Shadow more than covers the Moon's nearest Edge to the Middle of that Shadow, or Eclipse.

Direct. A Planet's Motion is direct, moving according to the following Order of Signs; as from *Aries* to *Taurus*.

Disk of the Sun and Moon. Their round flat *Faces*, as they appear at a Distance.

Disk of the Earth. Her Face, as seen from the Sun or Moon; or from other Planets; being equal to the *Difference* between the Sun and Moon's horizontal *Parallax*.

E.

Earth. The Globe we inhabit; carried round its Orbit, called the Ecliptic, in 365 D. 5 H. 48 M. 55 S. but to the same *fixed Star* in 365 D. 6 H. 9 M. 24 S. keeping its *Axis* always parallel to itself. Whose swift Rotation causes its Figure to be *flatted* next its Poles, and swelled out about its *Equator*. Its *equatorial* exceeds its *polar* Diameter by about 63 Miles; Sir *Isaac Newton* having proved the *equatorial* to the *polar* Diameter in the *Ratio* of 698 to 692. — Whence, according to *Norwood*'s Measure of the Miles in a Degree of a great Circle, the Earth's

$$\left.\begin{array}{lr} \textit{Circumference} & 25035.83 \\ \textit{Diameter} & 7969.15 \\ \textit{Height of the Atmosphere} & 47.11 \end{array}\right\} \textit{English } \text{Miles.}$$

Eccentricity. The Distance from the Center to the *Focus* of a Planet's Orbit.

Elongation. A Planet's farthest *angular* Distance from the Sun, as seen from the Earth. *Mercury*'s Elongation is never more than 28° 21′ 8″, nor less than 17° 35′ 42″. *Venus*'s never more than 47° 38′ 35″, nor less than 44° 56′ 14″.

Emersion. When a Planet, or Satellite, eclipsed, begins to recover its Light.

Epact. The *Difference* between the *solar* and *lunar* Year, of $365^d\,5^h\,49^m$ and $354^d\,8^h\,49^m$, or $10^d\,21^h\,0^m$; being reckoned 11 whole Days, the Days of the Month sooner the Moon *changes* in the following than in a former Year.

Ephemeris. A yearly and daily Account of the Places of the *cœlestial* Bodies.

Equation. The *Difference* between one Quantity and another to which it is to be *equated*. As the *Difference* between the Planet's mean and true Places, Anomalies, *&c.* or Equation of mean to *apparent* solar Time.

Eridanus. A Southern Constellation, or the River.

F.

Fomahaut. A Star of the *first* Magnitude in the Mouth of the Southern *Fish*.

G.

Golden Number. The Number of the *Moon*'s Cycle.

H.

Heliacal Rising. When a *Star* recovers from the Sun's Light to the *Westward*, so as to be seen again in the Morning *before* the Sun.

Heliacal Setting. When a *Star* first becomes invisible, by the Sun's near Approach. The Moon being large, can be seen 17° from the Sun, when the other Planets cannot be seen till they are near 30° distant from him.

Heliocentric Place. The Place of a Planet as seen from the Sun; from whence all the Planets appear to move direct, according to following Order of Signs; and the *heliocentric* Latitude is the same with the Inclination of the Planet's Orbit with the Ecliptic.

Horizon. The great Circle of the Heavens, bounding our Sight; dividing the upper from the lower Hemisphere. It is distinguished into *sensible*, as what we see from the Earth's Surface; and *rational* Horizon, as what it would truly appear, if we beheld it from the Earth's Center.

Hour Circles. The same as Meridians; or great Circles cutting the equinoctial right Angles, at any Hour of the Day or Night.

Hypothesis. A System, Theory, or Conjecture, to explain Appearances by; which is the more consistent with Truth and Reality, the more it corresponds, in general, with Observation.

I.

Jewish Hours, otherwise called *Planetary Hours.* The twelfth Part of the Day (of the Sun's Light) from Sun Rising to Setting; and the twelfth Part of the Night, from Setting to Rising of the Sun: Being the antient *Jewish* Account of Time.

Illuminative Month. The Space of Time the Moon is visible from Conjunction to Conjunction.

Immersion. When a Planet or Satellite first begins to be eclipsed.

Jupiter. Marked ♃. One of the *primary* Planets, next to the highest, or *Saturn*. He moves round the Sun in 11 Yrs. 313 D. 5 H. 35 M. 4 S. Inclination of his Orbit, 1° 20′. Diurnal Motion, 4′ 59″. The Law of his Motion about the Sun is such, that the *Square* of his periodical Revolution is as the *Cube* of his *mean Distance* from the Sun, compared with that *immutable* Law, observed in the Motion of the Rest of the Planets; first discovered by *Kepler*, and since demonstrated by Sir *Isaac Newton*. Mr. *Flamstead* and Dr. *Halley* observed that *Jupiter* moved too slow by the *Tables*, which were corrected accordingly.

K.

K.

Kepler, John. Of *Wittemberg*, in *Germany*, flourished in 1620; he was Mathematician and Astronomer to three *Emperors*; and was the first who discovered the *elliptical* Orbits of the Planets, and that their *periodical* Times were as the *Cubes* of the Distances from the Sun. And explained the general *Phænomena* of solar Eclipses. In the Year 1618 he published his Epitome, intitled *Astronomiæ Copernicanæ: Ephemerides de Harmoniâ Mundi, Mysterium Cosmographium:* Likewise, *De Motibus Stellæ Martis*, and other Pieces of Astronomy.

L.

Latitude of a Star or Planet. The Distance of either from the *Ecliptic*; measured on the Arch of a Circle of Latitude, passing through the Center of either, and the *Poles* of the Ecliptic.

Libration of the Moon. 1. In *Longitude*, being a Motion arising from the Plane of that Meridian of the Moon in general, nearly turned towards us; not directed towards the Earth; but towards the other *Focus* of the Moon's *elliptic* Orbit; whereby to an Eye at the Earth she appears to *librate* to and fro. 2. In *Latitude* arising from her *Axis* not being perpendicular, but inclined to the Plane of her Orbit, whereby sometimes *one* of her Poles and sometimes the *other* dips a little towards the Earth. 3. A *Libration*, whereby one Part of the Moon is not really turned towards the Earth as in the former Manner; but another is illuminated by the Sun. For her *Axis* being nearly perpendicular to the Plane of the Ecliptic, when she is at her greatest Southern Limit of the Parts adjacent to her North Pole, will be illuminated by the Sun, while the *contrary*, or South Pole, will be involved in Darkness.— These *Librations* are completed in her synodical Month. See *Newton's Principia*.

Limits of Eclipses. Sun or Moon's Distances from the Node at new or full Moon, within which Distances all *solar* or *lunar* Eclipses must happen.

		Fr. Node.	Lat. Moon.	
Greatest Limit	Moon	12° 2′ 5″	1° 2′ 23″	Greater than which Distances from the Node, or Latitude of the Moon, no Eclipse of the Moon or Sun can happen, at nearest
	Sun	18 20 4	1 34 14	Distances of the Sun and Moon from the Earth.
		Fr. Node.	Lat Moon.	
Least Limit	Moon	10 19 13	0 53 2	Greater than which Distances from the Node, or Latitude of the Moon, no Eclipse of the Moon or Sun can happen, at farthest
	Sun	16 35 1	1 25 30	Distances of the Sun and Moon from the Earth.

M.

Mars. Marked ♂, One of the *primary* Planets; moving round the Sun, in an Orbit between the Earth and *Jupiter*, in 1 Yr. 321 D. 22 H. 18 M. 18 S. His *diurnal* Motion, 31′ 27″. The *Inclination* of his Orbit to the Ecliptic, 1° 52′; being 15 Times less than our Earth. His Colour is ruddy like that of the Star *Aldebaran*; and is *retrograde* once in two Years.

Medium Cœli. The Degree or Point of the Ecliptic on the Meridian at any Time of the Day.

Mercury. Marked ☿. One of the *primary* Planets; moving through his Orb next the Sun, in 87 D. 23 H. 14 M. 34 S. His mean heliocentric *diurnal* Motion 4° 5′ 32″. The *Inclination* of his Orbit with the Ecliptic, 6° 59′; being never more elongated from the Sun than 28° 21′ 28″, and therefore seldom seen. — He appears retrograde 4 or 5 Times every Year; and is 27 Times less than our Earth.

Meridional Parts. Tables fitted for the Use of *Navigation*, from a Projection of the Earth's Surface, where the Meridians increase as the Parallels of Latitude decrease. For as all the *Parallels* end in a Point at the Pole, so the *Parallel* Meridians, being infinitely continued, never meet.

Micrometer. An Instrument invented by Mr. *Townly*, fitted to a Telescope, for taking the Diameters of the Planets.

Month, lunar or periodical The Time the Moon is going through her Orbit, 27^d 7^h 43^m.

——— *Synodical.* From her Conjunction to the next Conjunction with the Sun, in 29^d 12^h 44^m.

——— *Solar.* Time of the Sun going through one of the Signs in the Ecliptic about 30½ Days, but all of different Length.

——— *of twenty eight Days.* Nearly equal to the periodical Month.

——— *of the Calendar.* More or less Days as in the Calendar.

Moon. Marked ☽, a *secondary* Planet; moving round the Earth, to the same fixed Star, in 27 D. 7 H. 43 M. 5 S. but returns not in Conjunction with the Sun, till 29 D. 12 H. 44 M. 3 S. *&c.* While the Earth moves round the Sun in 365 D. 5 H. 48 M. 55 S. Her Orbit intersects the Ecliptic in two opposite Points, called *Nodes*. She is 50 Times less than our Earth.

Moon's Inclination of her Orbit with the Ecliptic. 4° 59′ 35″ in Conjunction and Opposition,
5 17 20 in Quadrature with the Sun.

N.

Nadir. The Point of the Heavens under the Earth; diametrically opposite to the *Zenith* above it.

Nodes. The Points where the several Orbits of the Planets intersect the Earth's Orbit, or Ecliptic; having a slow *progressive* Motion, as well as the *Aphelion* Points.

Nonagesimal Degree. The 90th Degree or highest Point of the Ecliptic at any Time of the Day or Night; whose Altitude is always equal to the Angle that the Ecliptic makes with the Horizon; which is also equal to the Distance between the Pole of the Ecliptic and Vertex or Zenith of the Place.

Nychthemeron. A *natural* Day in the Planets; including a Day of Light, and Night, where the Sun sets in a diurnal Revolution of the Planet; being with us 24 Hours.

O.

Oblique Ascension. The Degree and Minute of the Equinoctial, rising with the *Sun, Moon,* or *Planets*, in an oblique Sphere.

Oblique Descension. The Degree and Minute of the Equinoctial, setting with the *Sun, Moon,* or *Planets*, in an oblique Sphere.

Occultation. The Time that a *Star* or *Planet* is hid from us; when eclipsed by the Interposition of the Body of the Moon, or some other Planet, betwixt it and our Sight.

Orthographic Projection of the Sphere. Drawing the Superficies of a Sphere on a Plane, cutting it in the Middle, the Eye being placed at an *infinite* Distance vertical to one of the Hemispheres; in which all the Hour Circles become Ellipses: The same with *Analemma.*

P.

Parallax. The *Difference* between the true Place of a Planet, as seen from the Earth's Center, and its apparent Place as seen from the Earth's Surface

Parallax in the annual Orbit. The Angle the Earth would appear under to the Eye, at each Planet, to be elongated from the Sun; being greatest and least at extreme Positions.

Path of the Vertex. A Circle described by any Point of the Earth's Surface, by the Rotation about its *Axis.* This Point is considered as *vertical* to the Earth's Center; being the same with *Vertex* or *Zenith.* The Semidiameter of the *Path* of the *Vertex* is equal to that of the Complement of Latitude of the Place describing it.

Penumbra. A *faint* Shadow, or outmost Edge of the *dark Shadow* of the Earth, in an Eclipse of the Moon: It being difficult to determine where the dark Shadow begins, and where the Light ends, in *(solar)* Eclipses of the Earth, by the Moon's Shadow. The Penumbra's Semidiameter is equal to the Sum of the apparent Semidiameters of the Sun and Moon. For if, at any Time of the *true* Conjunction of the *Sun* and *Moon,* none of the *Penumbra* falls within the Earth's Disk, the Sun will then be *no where* seen eclipsed.

Perigeon. A Planet's *nearest* Distance to the Earth. When the Moon's mean Anomaly is 6 Signs she is then in Perigeon, and her diurnal Motion about 15°. This Point is opposite to the *Apogeon,* both at the Extremes of the transverse Diameter of her elliptic Orbit.

Perihelion. A Planet's nearest Distance to the Sun; the *heliocentric* Motion being here the *swiftest,* with 6 Signs Planet's mean Anomaly.

Place of the Sun or Planet. The same with Longitude.

Place true and apparent. As seen from the Earth's Center and Surface, respectively.

Poetical Rising and Setting of Stars. *Achronical, cosmical,* and *heliacal,* before described.

Precession of the Equinoxes. The *fixed* Stars are immoveable; the Earth travels round the Sun in its *annual* Orbit, with its *Axis* carried 66° 31′ 30″, inclined to the Plane of the Ecliptic: And by the Earth's diurnal Motion East, round its *Axis,* in 24 Hours, the Equinoctial Points are moved *contrary* at about 50″ yearly; whereby the *fixed Stars* are made to go forward in a following Order of Signs, yearly, as much.

Projection of the Sphere. A geometrical Delineation of the Circles of the Sphere, or any assigned Part, on the Plane of any great Circle, as on the *Horizon, Meridian, Equinoctial, Ecliptic, Colures,* or on the *Tropics,* &c. being either *stereographic,* supposing the Eye 90° distant from, and perpendicular to the Place of Projection; or *orthographic,* the Eye being at an *infinite* Distance, in the Center of Projection.

Ptolomy. *Claudius Ptolomeus.* A Native of *Pelusium,* a City of *Africa,* in *Egypt*; who flourished 135 Years after *Christ*; and was Author of the *System* known by that Name.

R.

Radius. The Semidiameter of a Circle. A *mean* Proportional between the *Tangent* and *Cotangent* of any Arch. A *mean* Proportional between *Sine* and *Secant* Complement of any Arch.

Ratio. The particular *Relation,* or Habitude, of two Numbers. The *Similitude* of *Ratios* signifies Proportion, or Analogy.

Simple, duplicate, triplicate, quadruplicate, &c. Ratio. Is the single, square, cube, 4th Power, &c. of two Quantities.

Subduplicate, Subtriplicate, &c. Ratio. The *square, cube* Root, &c. of two Quantities, &c.

The sesquiplicate Ratio. Is the one and $\frac{1}{2}$ or $\frac{3}{2}$ Power, consequently *subsesquiplicate Ratio,* the $\frac{2}{3}$ Root, and the subquintuplicate *Ratio,* the $\frac{1}{5}$ Root, of any two Quantities; and so of the *Rest.* *Leadbetter,* in his Astronomy, has misrepresented what a *Ratio* is, in every Case and Circumstance; giving a wrong *Idea* thereof.

Ratios.	a to b the simple.	$a^{\frac{1}{2}}$ to $b^{\frac{1}{2}}$ the subduplicate.	*Ratios.*
	a^2 to b^2 the duplicate.	$a^{\frac{1}{3}}$ to $b^{\frac{1}{3}}$ the subtriplicate.	
	a^3 to b^3 the triplicate.	$a^{\frac{3}{2}}$ to $b^{\frac{3}{2}}$ the sesquiplicate.	
	a^4 to b^4 the biquadrate.	$a^{\frac{2}{3}}$ to $b^{\frac{2}{3}}$ the subsesquiplicate.	
	&c.	$a^{\frac{1}{5}}$ to $b^{\frac{1}{5}}$ the subquintuplicate, &c	

Recession of the Equinoxes. Going back of the Equinoctial Points, about 50″ in each Year; caused by the Earth's *spheroidal* Figure, in its diurnal Motion.

Reduction of the Orbit to the Ecliptic Place. The Angle between the *Axis* of the Ecliptic and *Axis* of the Planet's Orbit; being equal to the Ecliptic's Arch between the *two Axes.*

Reflection. The Pole's Distance from the Horizon of the *Disk.* — The same as the Sun's Declination.

Refraction. Produced by the Atmosphere, making a Star appear more elevated than it really is.

Retrogradation. Going back, in a contrary Order of Signs: as the Moon's North *Node* moves retrograde upon the whole of its Motions.

Right Ascension. The Degrees of the *Equinoctial,* reckoned from the Beginning of *Aries,* coming to the *Meridian* with a Star or Planet; or to any Hour Circle, at right Angles with the Equinoctial.

S.

S.

Saros, Chaldean. Of 18 Yrs. $11^d\ 7^h\ 43^m$, when 4 Leap-Years intervene — but only 18 Yrs. $10^d\ 43^m$ when 5 Leap-Years intervene. — The same as *Plinian* Period.

Satellites. Secondary Planets, revolving round their respective Primaries, as the Moon round the Earth; the Satellites of *Jupiter* and *Saturn* round those Bodies.

Saturn. Marked ♄, One of the *primary* Planets; the highest in all our System; moving round the Sun in 29 Yrs. 158 D. 13 H. 14 M. 4 S. His diurnal Motion 2′. Inclination of his Orbit 2° 33′. He is retrograde once every Year.

Scenographic Projection. The same as Perspective.

Sidereal Day. The Time between any *fixed Star* departing from, to its Return to, the same Meridian; being $23^h\ 56^m\ 4^s\ 6^{th}$, Parts of a mean solar Day.

Sidereal Year. The Time of the Sun going from a fixed *Star* to his Return to the same, $365^d\ 6^h\ 9^m\ 24^s$, &c.

Solar Year. The Time of the Sun's going from, to his Return to, the same Point of the Ecliptic; called also *tropical Year*, of about $365^d\ 5^h\ 48^m\ 55^s$.

Street's Computation. 1. Having found the Moon's mean Anomaly, Apogee, and Node; you find the *eccentric* Equation answering to her mean Anomaly, which being added to, or subtracted from, the said Anomaly, according to its Title, you have thence the 1. *equated* Anomaly of the Moon; to which adding the Moon's Apogee, you have 1. *equated Place* of the Moon.

2. From the 1st *equated Place* of the Moon take the Sun's true Place, and the *Residue* is the Distance of the Moon from the Sun, by which you may take out the Equation of Variation (as at P. 74, according to *Horrox)* which *added* to or *subtracted* from the 1st *equated* Anomaly (before found) will give the 2. *equated* Anomaly of the Moon.

3. The *synodical* Anomaly being found, as under that Term, take its Half, if less than 6 Signs, but the Half of its Supplement to 12 Signs, if above 6 Signs.

4. To the *Logarithm* 3.640432, of the Diameter of the Circle of *Evection*, add the Log. Sine of the Moon from the Sun *(before found)* which *Sum*, rejecting Log. of Radius, will be the Log. of the Chord of Evection. This Logarithm to be taken from the Logarithm of the Moon's Distance from the Earth *(found in a Table)* adding the Logarithm of Radius to the Remainder, will be the *Tangent* of an Arch, from which reject 45°.

Now, say, As *Radius to the Tangent of this Remainder, in Degrees, so the Tangent of half the synodical Anomaly, or Tangent of Half its Supplement to* 12^s, (before found) *to the Tangent of an Arch, whose Difference from that Half will be the* Evection-Equation *to be added or subtracted according as the whole synodical Anomaly is more or less than* 6 *Signs*. — With which *Evection-Equation* you must connect the Variation, or *Reflection*, according to its Sign, (before found) for an Equation; which being connected with the Moon's Place 1. *equated*, will give her *Orbit-Place*; which is reduced to her *Ecliptic* Place, by the Reduction-Equation, found as *usual*.

The *true* Place of the Node (2. *equated)* being taken from the Moon's Orbit-Place, the Remainder will be the *Argument of Latitude*.

By the Distance of the Moon from the Sun, you find the *Excess* of the greatest Latitude above the present Latitude.

5. To find the present Latitude. — As *Radius to the Sine of the Argument of Latitude*, so is *the Sine of the greatest Latitude*, to *the Sine of the* present *Latitude*.

To find the Reduction. — As *Radius* to *Cosine of the greatest Latitude*, so is *Tangent of the Argument of Latitude* to *Tangent of an Angle, whose Difference from the former is the Reduction.*

*** *Leadbetter*, in his Astronomy, has used *Street*'s Logarithms of the Distance of the Moon from her Earth, according to her mean Anomaly, as he has also used *Street*'s Diameter of the Circle of Evection, and also Variation Equation, yet has deviated from this Computation, in using *Newton*'s central Equation to the *greatest* Eccentricity, instead of *Street's Eccentric*; the Maximum of the latter being 5° 1′ 43″ and of the former but 4° 57′ 56″; being 3′ 47″ different. *Leadbetter*'s Logarithm of the Chord of Evection computed to every Degree of the Moon à Sun saves no Labour; being more difficult and less certain to proportion the Logarithm of the Chord of Evection to the odd Minutes and Seconds of Moon à Sun, then to gain that Logarithm by adding the Logarithm Sine of Moon à Sun to the given Logarithm of the Diameter of Evection Circle, *viz.* 3.640432.

Sun. The Globe of Fire placed in the Center of our System, revolving round its *Axis* in $25\frac{1}{2}$ Days; and giving Light and Heat to the whole.

Symbols. ′ (cross a trigon. Fig.) *given.*	× *Multiplication.*	√ *Square Root.*	T. *Tangent.*	∵ *Therefore.*
o *Required.*	÷ *Division.*	S. *Sine.*	Cot. *Cotangent* or t′.	: *To.*
R. *Radius.*	= *Equal.*	Cos. *Cosine* or S′.	° *Degrees.*	:: *So is.*
+ *More.*	∠ *Angle.*	Sec. *Secant.*	′ *Minute.*	△ *Triangle.*
— *Less.*	∠s *Angles.*	Cosec. *Cosecant* or s′.	″ *Second.* ‴ *Third,* &c.	□ *Square.*

Synodical Anomaly. From Syzygies to *Quadratures* is the Moon from Sun less than 3 or 9 Signs *added* to the Moon's mean Anomaly 2. *equated*, by her Eccentricity and Variation. — From the Quadratures to the *Syzygies* is the Moon from the Sun more than 3 or 9 Signs *subtracted* from the Moon's mean Anomaly 2. *equated*, as before. This is according to *Street's Lunar Theory*; who determines the Moon's *true Place*, from her mean Place, at any Time, by Means of 3 Equations. The first of her Center, for the *greatest* Eccentricity (called the *eccentric* Equation) the *Evection-Equation* correspondent to the *Difference* of present Eccentricity from the *greatest* (making together the *whole* central Equation) and the third, the Variation-Equation (otherwise called the Reflection) used before to equate the 1. equated Anomaly. Which three Equations give the Moon's Place sometimes very near the Observation. However this Method of Computation seems to want Improvement, in a new Circle of *Evection*, new *eccentric* Equation, and new *Variation*.

EXPLANATION of TERMS.

Syzygies. The Conjunction or Opposition of the Sun and Moon.

T.

Time of Incidence. The Time from the Beginning to the Middle of an Eclipse. In the Moon's Eclipse it is equal to Half the Time of Duration.

Time of Repletion. The Time from the Middle to the End of a solar Eclipse.

Transit. The Passing of one Planet by, or over, another.

V.

Vector. A Line drawn from any Planet moving round the Sun, or *Focus* of its Orbit, describing equal *Areas* in equal Times.

Venus. Marked ♀, One of the *primary* Planets; the brightest of all. When she is West, at her greatest Elongation from the Sun, she sometimes shines extremely bright. She has her Increase and Decrease of Light from the Sun, like the Moon; and moves in an Orb, between the Earth and *Mercury*, round the Sun in 224 D. 16 H. 49 M. 24 S. and is never farther from the Sun than 47° 38′ 35″. She has the *least Eccentricity*, but greatest geocentric Latitude. —For being in ♒, retrograde, her Latitude is above 8° N. and being in ♍ retrograde, she has about 9° Latitude S. *In every 8 Years she is seen in the same Place of the Heavens.*

Vortex. A System of Particles of Matter, according to the *Cartesian* Philosophy, rapidly moving round like a Whirlpool; by which the *French* Mathematicians endeavoured to solve the Motions of the cœlestial Bodies: But being proved absurd, and contrary to Experience, by Sir *Isaac Newton*, it was exploded.

X.

Xiphias. The Sword-Fish; a Southern *Constellation.*

Y.

Year. The Time of the Earth's Revolution through the Ecliptic, in 365 D. 5 H. 48 M. 55 S. called *tropical* Year, or its Return to the same fixed Star, in 365 D. 6 H. 9 M. 24 S. called *sidereal* Year.

Z.

Zenith. The Point of the Heavens directly over our Heads, otherwise called the *Vertex*; diametrically opposite to the *Nadir.*

Zodiac. A Zone or Girdle surrounding the Heavens, crossing the *Equinoctial*, in *Aries* and *Libra*, at an Angle of 23° 28′ 30″, equal to the Sun's greatest Declination. The Middle of which Zodiac is the *Ecliptic.* The Breadth of the Zodiac is 18° 30′; taking in the Latitude of all the Planets. It is equally divided into 12 Parts, called Signs, denominated *Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittary, Capricorn, Aquarius,* and *Pisces*; being *Constellations* of those Names in the Zodiac.

DEFINITIONS of QUANTITY.

Def. I. Whatever *Being*, or *Object*, consists of Parts, and is capable of being augmented or diminished, is called *Quantity.*

Corollary 1. *Hence there is Quantity of Extension, Number, Weight, Measure, Motion, Time,* &c. *taken more or less, heavier or lighter, longer or shorter, swifter or slower,* &c. *relative to the same Kind:* great *and* small *being but comparative Terms for Things of the same Kind.*

2. *And as the principal Property of* Quantity *is in its being capable of* more *or* less, *therefore* Quantities *may be added to, subtracted from, and multiplied by, one another, or divided into the Parts they contain.*

Def. II. All *Quantities* have their Parts united or separated.

Def. III. Quantity having its Parts separated is called *Multitude*, or *Number*, being the Subject of Arithmetic.

Def. IV. Quantity having its Parts united is called *Magnitude*, being the Subject of Geometry.

Def. V. The *mutual* Relation of *two Quantities* of the same Kind compared together, is called a *Ratio*; and the Similitude of Ratios of Quantities is called *Proportion.*

Def. VI. The Knowledge of the Comparisons, Properties, and Relations of *Quantities (Ratios* and Similitude of *Ratios)* is the Subject of Mathematics; including *Fluxions, Algebra, Arithmetic,* and all subordinate *Methods* of Computation.

Corol. 1. *Hence, a Part of Quantity is only considered in Relation to the* whole, *and may be taken as an indivisible* Component *of it, or for that whose farther Divisibility is not considered.*

2. Unit *signifies any Quantity, considered as indivisible.*

3. Number *is a Name of Quantity consisting of a Collection or Sum of Units, whether considered as Parts of a whole, or of several whole Quantities together.*

4. Integer *is a Name of Quantity considered as consisting of whole Units.*

5. Fraction *is a Name of Quantity considered as consisting of Parts of an Unit, or whole Quantity.*

Some

Some *Ancient* OBSERVATIONS *of* Solar *and* Lunar ECLIPSES *compared with the* Computations *from the* Tables *in the* Royal Astronomer, *corrected by the new* Table *of* ACCELERATION, *at P.* 374. *According to* D. C.

	Computation.	
1. A *Total* Eclipse of the Sun, *June* 16, *Anno Chr.* 364. According to Mr. *Dunthorne.* (*See Ph. Transact.* Vol. XLVI. P. 168.) at app. T.	$2^h\ 4^m\ 20^s$	
Under the Meridian of *Greenwich* the Moon was in *Conseq.* with the Sun . .	$0^s\ 0^\circ\ 39'\ 41''$	
The Sun's Ecliptic *Longitude* by the *Tables* was then . . .	♊ 25 9 49	
Therefore the Moon's true Ecliptic Longitude was . . .	♊ 25 49 30	Error —
But by the Tables thus corrected . . .	♊ 25 45 54	$3'\ 36''$
2. A *partial* solar Eclipse, *December* 12, *Anno Chr.* 977, at . . .	$19^h\ 12^m\ 30^s$ *App. Time.*	
Under the same *Meridian* the Moon was in *Anteced.* to the Sun . . .	— $43'\ 39''$	
The Sun's Ecliptic Longitude by the *Tables* being then . . .	♐ 27 8 53	
The Moon's Ecliptic Longitude *observed* was . . .	♐ 26 25 14	Error +
But by the *Tables* was . . .	♐ 26 26 12	$0'\ 58''$
3. Another *partial* Eclipse of the Sun, on *June* 8, *Anno Chr.* 978, at . . .	$1^h\ 16^m\ 10^s$ App. Time.	
Under the same Meridian the Moon was in *Consequentia* . . .	+ $29'\ 3''$	
The Sun's *Longitude* by the *Tables* was then . . .	♊ 21 53 1	
The Moon's *observed* Ecliptic *Longitude* was therefore . . .	♊ 22 22 4	Error +
By the *Tables* was . . .	♊ 22 22 34	$0'\ 30''$

N. B. The first of these was observed at *Alexandria*, in *Egypt*, by *Theon*. The two last at *Grand Cairo*; and are the same as are quoted by *Mayer* in the *Prolegomena* to his *Tables*.

☞ The *antient* Astronomers were so negligent in their *Observations*, that hardly any can be depended on, as *Dunthorne* remarks, for establishing the *Certainty*, much less the Quantity of the Moon's Acceleration, at different Times. And yet there are a *few* attended with such *lucky Circumstances*, that they serve, as he observes, not only to establish the *Hypothesis*, but to settle the Quantity of the *Acceleration* of the Moon. I shall therefore add these, as they lie in *Dunthorne*'s Letter to Mr. *Mason*, and compare the Computations from the *corrected Tables* with them.

1. The first is said by *Hipparchus*, to have been observed at *Babylon*, in the 366th Year of *Nabonassar*, the Night between the 26th and 27th Days of *Thoth*; when a small Part of the Moon's *Disk* was eclipsed from the *North-East*, Half an Hour before the End of the Night, and the Moon set eclipsed. This was in the Year before *Christ* 383, (falsely printed 313) *December* 22. The Sun rose then at $7^h\ 12^m$; and as the Moon then had South *Latitude*, her Setting must have been something sooner.

Computation.
Beg. $7^h\ 11^m\ 30^s$
Midd. 7 58 0
Dig. Lat. $2^\circ\ 12'$
The Beg. by Comp. just at Sun-rise: therefore the Time by Tables about 15^m *too late.*

2. It is also said, by *Hipparchus*, to be observed in the 54th Year of the second *Callipic* Period, at *Alexandria*, the 16th Day of *Misson*; when, he says, the *Moon* began to be eclipsed Half an Hour before her *Rising*, and was wholly clear again in the *Middle* of the third Hour of the Night. This was in the Year before *Christ* 201, *September* 22. The Sun set about 7^m after *six*; and the Moon being in *Anteced.* with N. *Latitude*, her true Rising had been somewhat sooner; but the *Depression* by *Parallax*, over and above Refraction, brings the Times to a near Equality.

Computation.
Beg. $5^h\ 34^m\ 42^s$
End 8 42 0
Dig. Ecl. $9^\circ\ 0'$
These Times correspond as near as can be expected, and being not 2 Centuries after the former: the Error of that may partly arise from the computed Duration being too small, partly from the assumed Longitude of Babylon *being too great.*

3. The most antient *Eclipse* recorded, is related by *Ptolemy*, to have been observed at *Babylon*, the first Year of *Mardokempad*, in the Night, between the 29th and 30th Days of *Thoth*, in which the *Moon* began to be eclipsed, when one Hour after her Rising was fully passed. This *Eclipse* was in the Year before *Christ* 721, on *March* 19. The *apparent* Rising of the *Moon* was at $5^h\ 46^m$. The Sun-Setting at $5^h\ 48^m$.

Computation.
Beg. $6^h\ 57^m\ 12^s$
Mid. 8 51 0
End 10 45 0
The Beginning of this also agrees very nearly with the Computation: The Words admitting of Latitude. But if Babylon *should be* 40′, *and not* 50′ *East of* Alexandria, *both Computations will correspond; and the Longitude of* Babylon *has not been determined since* Ptolomy's *Days.*

*** In regard to the *Acceleration* of the *Apogee* and *Node*, supposed by Mr. *Morris*, if it had been founded on Observation, the solar *Eclipses* in 977, and 978 were, of all others, the most likely to have discovered the *Quantity*, as well as *Reality* of it: As they happened one near the *Perigeon*, the other near the Apogeon of the Moon's Orbit. But we see as near a Conformity of the *Error* of Computation as can be expected. And the Acceleration of the Moon's Anomaly being then nearly equal to 40′; it being the Sum of the Correction of the Moon's mean *Motion*, and twice the Acceleration of the Moon, the Equation of *Longitude* thence arising would be about 4′ in the *Perigeon New Moon*; and 3′ in the *Apogeon*. Which would give the Errors of the above *Eclipses*, in *December* 977 . . + $5'\ 0''$
in *June* 978 . . — 2 30

I do not doubt but *Mayer* omitted a Correction of the *Apogeon* from the observed Disagreement with *Observation*.

As to the Acceleration of the Moon's *Nodes*, I can say Nothing to it from a Comparison of *ancient* Observations; but I think there is as little Reason to suppose any. S. C. ——— *December* 9, 1760.

LUNAR

LUNAR ECLIPSES.

Yrs	M.	D.	Errors		Yrs	Diff.
1628	January	10	1′ 54″	+	54	— 1′ 17″
1682	February	11	0 37	+	54	— 0 27
1736	March	15	0 10	+		
1638	Decem.	10	1 36	+	54	— 0 52
1693	January	11	0 54	+		— 1 14
1747	February	13	0 20	—		
1642	April	4	1 26	+	54	— 0 52
1696	May	6	0 34	+		— 0 24
1750	June	8	0 10	+		
1681	August	18	1 11	+	54	— 0 51
1735	Septemb.	20	0 20	+		
1685	Novemb.	30	0 46	+	54	— 0 53
1740	January	2	0 7	—		

N. B. The Moon's *Places are corrected by the Reduction of 6. and 7.* Equations.

Total 410″
Divided by 8 = — 51″⅛
In one Century — 95″

SOLAR ECLIPSES.

Yrs		M.	D.	Errors		Yrs	Diff.
1661	D.	March	19	0 8	+	54	— 0 42
1715	L.	April	21	0 34	—	18	+ 0 42
1733	L.	May	2	0 8	+		
1676	D.	May	31	0 38	—	72	+ 0 57
1748	Gr.	July	14	0 19	+		
1699	O.	Sept.	12	0 9	—	54	— 0 3
1753	Go.	Oct.	14	0 12	—		

Places of Observation, *Dantzick, London, Oxford, Greenwich,* and *Gottingen.*

LUNAR COMPUTATIONS for 1690 and 1744, from *Mayer's Tables,* compared with OBSERVATIONS, by *Flamstead,* and *Bradley,* at the *Royal Observatory.* According to D. C.

Yrs	M.	D.	Errors		Yrs	Diff.
1689	Decem.	12	0′ 13″	+	54.	— 0′ 11″
1744	January	14	0 2	+		
1690	January	12	1 2	+		— 1 49
1744	February	13	0 47	—		
1690	February	7	1 53	+		— 2 0
1744	March	11	0 7	—		
1690	February	8	2 23	+		— 2 51
1744	March	12	0 28	—		
1690	February	14	0 22	—		— 0 19
1744	March	18	0 41	—		
1690	February	19	0 6	+		— 1 6
1744	March	23	1 0	—		
1690	March	6	1 24	+		— 2 5
1744	April	7	0 41	—		
1690	April	8	2 10	+		— 2 12
1744	May	10	0 2	—		

N. B. *The mean* Radixes *are reduced to our* Radixes, *in these* Computations.

Total — 753″
÷ 8, = — 94″⅛
In one Century — 2′ 54″

The Mean of Differences gives, at an Average, 3′ nearly, for a Century; but they are so very unequal that one can only lament the Carelessness of the 1st Observers.

If we take a Mean between the Differences in lunar Eclipses, and those made from *Transits,* the *Acceleration* of mean Motion for a Century, above our Tables, will be 2′ 16″. —The *Computations* from *solar Eclipses* prove Nothing; which I wonder at, as the Times of *Beginning* and *End* are more easily to be determined than in *lunar* Eclipses. I suppose the Errors of Latitude or *Parallax* may account, in some Measure, for it. It is surprizing too, that the *Seven* should agree so much nearer with Observation than the same Number of *lunar* ones. — But, by comparing the *ancient* observed *lunar* Eclipses, with the Tables, and fixing the Acceleration at 10″ × by Sq. of the Centuries, the mean Motion is to be accelerated 2′ 20″ in a *Century,* according to the *Table of Correction* in P. 374. S. C.

Correction of the Index in last Page. ☞ D. *Cowper,* from the foregoing Observations and Remarks, made since the printing off the last Page, is doubtful whether the *Apogeon* and *Node* have been accelerated, since the *earliest* Ages; or rather, from the near Agreement in the *Errors* of Computation, in the two *famous solar Eclipses* of 977 and 978, (the one when the Moon was near the *Perigeon,* the other her *Apogeon)* is inclined to think they have none at all. But is of Opinion, if the Apogeon and Node be accelerated as well as the Moon, that the *Theory of Gravity* requires that their Acceleration should not be in the *Ratio* as is given by Mr. *Gael Morris,* (in the *Astronomia Arcana,* or *Greenwich* Tables, he has secretly printed for the Use of the PRIVATE) but in the *Ratio* of the annual Equations to each other, as 6, 10, and 5, very nearly. In which Proportions of Acceleration of the *Moon, Apogee,* and *Node,* the following COMPUTATIONS are made.

Two EXAMPLES of computing the MOON's PLACE. The Mean Motions corrected by P. 374. C.

	s ° ′	s ° ′	s ° ′	
☉ Long.	♊ 3 29	☉ 2 3 29	11 12 49	☽ An.
☉ M. Anom.	10 23 30	Ap. ☽ 7 5 32	1 25 54	2. An.
		An. Ar. 6 27 57	9 16 55	∫ Arg. M. Ev.

	☽ s ° ′ ″	Ap. s ° ′ ″	☊ s ° ′ ″
1733	8 1 3 58	6 20 25 40	8 8 27 8
May 13	10 12 27 38	14 49 2	7 2 35
Hours 9	4 56 28	2 30	1 12
Mo. Sec. 33	. . . 18		
			— 7 3 47
M. Motions.	6 18 28 22	7 5 17 12	8 1 23 21
Ann. Equat.	— 6 38	+ 15 12	— 5 28
☽, Ap. & ☊ 1 Eq.	6 18 21 44	7 5 32 24	8 1 17 53
6 Equat.	— 9 18	6 18 21 44	6 20 36 50
☽ 7 Equat.	6 18 12 26	11 12 49 20	10 19 18 57
Elliptic Equat.	+ 1 45 47	— 9 18	6 Eq. ∫ ☽ à ☊
☽ 8 Equat.	6 19 58 13	11 12 40 2	☽ cor. Anom.
Evection	+ 1 16 17	+ 0 52 53	½ M. Ell. Equat.
☽ 9 Equat.	6 21 14 30	11 13 32 55	☽ true Anom.
Variation	— 37 40	1 25 54 —	2. Ann. Arg.
☽ Orb. Long.	6 20 36 50	9 17 38 55	Arg. Evec.
Reduct. + 20″	+ 7 13		
☽ in Eclipt.	♎ 20 44 3		
Observed	♎ 20 43 41		
Error of Computation	+ 0 22		
Halley's Error	+ 1 49		

N°.	Arguments s ° ′	Equations ′ ″	+
2	6 27 57	4 24	
3	6 2	3	
4	9 21	56	
5	8 13	1 20	
6	8 10	2 35	
7	10 24		
		9 18	

6° 21° 14′ ☽
2 3 29 ☉
4 17 45 ☽ à ☉

☞ *The* above *is an Improvement in the* Form *of the* lunar Computation *by* D. C. *who has commodiously placed the Argument of* Mean Evection, *at the Top of the Page, for taking out the less Equations. And has corrected the Mean Motions from Tab.* P. 374.

	s ° ′ ″	s ° ′	s ° ′	
☉ Long.	♊ 17 23 59	2 17 24 ☉	5 22 6	∫ ☽ M. An
☉ M. Anom.	♊ 8 24 26	7 7 3 Ap. ☽	2 20 42	2. An.
		7 10 21 An. A.	3 1 24	∫ Arg. M. Ev

	☽	Ap.	☊
1733	8 1 3 58	6 20 25 40	8 8 28 18
May 27	4 16 55 48	16 22 37	7 47 4
Hours 20	10 58 49	5 34	2 39
Mot. 27 S. 33	15 18	8	4
			— 7 49 47
M. Motions	0 29 13 53	7 6 53 59	8 0 38 31
Ann. Equat.	— 4 4	+ 9 23	— 3 22
☽ Ap. & ☊ 1. Eq.	0 29 9 49	7 7 3 22	8 0 35 9
6 Equat.	— 0 19	0 29 9 49	0 26 19 8
☽ 7 Equat.	0 29 9 30	5 22 6 27	4 25 43 59
Elliptic Equat.	— 0 55 47	— 0 19	6 Eq. ∫ ☽ à ☊
☽ 8 Equat.	0 28 13 43	5 22 6 8	☽ corr. Anom.
Evection	— 1 20 26	— 0 27 53	½ M. Ell. Eq.
☽ 9 Equat.	0 26 53 17	5 21 38 15	☽ true Anom.
Variation	— 34 9	2 20 42 —	2. Ann. Arg.
☽ Orb. Long.	0 26 19 8	3 0 56 15	Arg. Evection
Reduc. + 20″)	+ 6 49		
☽ in Eclipt.	♈ 26 25 57		
Observed	♈ 26 26 16		
Error of Computation	— 0 19		
Halley's Error	— 8 20		

N°.	Arguments s ° ′	Equations —	+
2	7 10 21	5 13	. . .
3	6 16 50	26	. . .
4	4 5 2	. .	0 49
5	2 16 7	. .	1 22
6	2 9 48	. .	3 9
7	3 23 0		
		5 39	5 20
		5 20	+
		0 19	

*** *The Moon's Latitude and Parallax are taken out of Tables, p. 52 and 53, by the proper Arguments, as shewn in* Examples, *p. 54. Of which these two last printed Examples are an Improvement by* D. C. *to whom no Task is insuperable!*

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CORRECTIONS *of* literal *and* typographical ERRORS obſerved; *to be made with the Pen, before our* WORK *is uſed.*

☞ *Moſt of the following Errors are obvious and trifling; but are all recited to prevent any being overlooked.*

N. B. *Where* b *is placed after the Number of a* Line, *it ſignifies the Number of that Line, from the* Bottom *of the Page.*

PAGE 1. Line 6. *b.* For $0^h\ 11^m\ 16^s$ and $2°\ 49'\ 4''$
Read 0 7 16 and 1 49 4.
L. 23. *b.* For *Lima* $86°\ 49'\ 0''$ r. $76°\ 49'\ 0''$.
P. 2. L. 1. For *Nantz* $0^h\ 24^m\ 55^s$ and $6°\ 13'\ 48''$ E.
Read 0 6 56 and 1 44 0 W.
L. 14. For *Porto Bello* $89°\ 50'\ 6''$ r. $79°\ 50'\ 6''$.
P. 11. L. 16. For *October* 1 r. *October* 5.
P. 23. L. 28. For $67°\ 30'\ 31''$ r. $67°\ 40'\ 31''$.
P. 24 to 27. Right Hand Col. For ☉ Pl. in Degs. r. its Comp. to 30°, or invert in writing the Degrees in that Column by Paper paſted over its Length and Breadth.
P. 72. L. 5. *b.* For *i. e.* 7,24 × any L. Eq. = G. D. r. *i. e.* ,1206 × any L. Eq. = G. D.
P. 73. L. 8. *b.* For 2. ☽ à ☉ (from next *Quadrature* or Syzygy) *&c.* r. S. 2. ☽ à ☉ (from next Quadrature or Syzygy) : S. Preſ. M. Variation, *&c.*
P. 78. L. 24. *b.* under *Col.* 7. For + r. + —.
P. 97. L. 18. *Col.* 2. For $0°\ 38'\ 35''$ r. $0°\ 28'\ 15''$.
P. 100. L. 31. *Col.* 8. For $6°\ 59'\ 38''$ r. $5°\ 59'\ 38''$.
P. 102. L. 7. *Col.* 8, 10, 12. For +, +, +, *(at Top)* r. —, —, —.
P. 119. L. 2. For elliptic *Trajections*, r. elliptic *Trajectories.*
L. 10. For Where the mean and true Motion is equal, r. Where the mean and true Anomalies are equal.

P. 120. L. 34. *b.*	For Com. Yrs.	r. Com. Yrs.
	1. +14 19 45	1. —14 19 45
	2. +28 39 31	2. —28 39 31
	3. +42 59 17	3. —42 59 17

P. 121. L. 8. *Col.* 3. For +,97017925237, r. +,97017886292, *&c.*
$29°\ 6'\ 19''\ 17'''\frac{1}{2}$ in a Lunat.
L. 28. *Col.* 1. For, from 1600 and 1700 reduce to, r. from 1700 reduce to.
L. 22. *Col.* laſt. For + $4'\ 3''$, r. $4'\ 1''$.
L. 33. *Col.* laſt. For, from 1600 and 1700, r. from 1700.

		For	r.
P. 122.	L. 1. *b.* *Col.* 3.	$21'''\ 36^{iv}$,	$21^{iv}\ 36^{v}$.
	4. *b.* ſame *Col.*	$8''\ 38'''\ 24^{iv}$	$8'''\ 38^{iv}\ 24^{v}$.
	1. *b.* *Col.* 5.	$4'''\ 6^{iv}$, *&c.*	$4'''\ 0^{iv}$, *&c.*
	1. *b.* *Col.* 6.	$23'''\ 15^{iv}$	$23^{iv}\ 15^{v}$.
	4. *b.* ſame *Col.*	$9''\ 18'''$	$9'''\ 18^{iv}$.
	1. *b.* *Col.* 7.	$12'''\ 45^{iv}$	$12^{iv}\ 45^{v}$.
	4. *b.* ſame *Col.*	$5''\ 6'''$	$5'''\ 6^{iv}$.
	10. *b.* ſame *Col.*	$31'''$	$31''$.
P. 123.	L. 21. *Col.* 3.	$11''\ 31'''\ 12^{iv}$	$11'''\ 31^{iv}\ 12^{v}$.
	24. ſame *Col.*	$28'''\ 48^{iv}$	$28^{iv}\ 48^{v}$.
	21. *Col.* 4.	$6''\ 14'''\ 24^{iv}$	$6'''\ 14^{iv}\ 24^{v}$.
	24. ſame *Col.*	$15'''\ 35^{iv}$	$15^{iv}\ 35^{v}$.
	21. *Col.* 6.	$11''\ 47'''\ 12^{iv}$	$11'''\ 47^{iv}\ 12^{v}$.
	24. ſame *Col.*	$29'''\ 32^{iv}$, *&c.*	$29^{iv}\ 32^{v}$, *&c.*
	21. *Col.* 7.	$8''\ 13'''\ 12^{iv}$	$8'''\ 13^{iv}\ 12^{v}$.
	24. ſame *Col.*	$20'''\ 33^{iv}$	$20^{iv}\ 33^{v}$.
	1. *b.* *Col.* 3.	$32'''\ 57^{iv}$	$32^{iv}\ 57^{v}$.
	3. *b.* ſame *Col.*	$12''\ 8'''$	$12'''\ 8^{iv}$.
	1. *b.* *Col.* 4.	$7'''\ 20^{iv}$	$7^{iv}\ 20^{v}$.
	3. *b.* ſame *Col.*	$2''\ 56'''\ 24^{iv}$	$2'''\ 56^{iv}\ 24^{v}$.

P. 124. L. 2. *b.* *Col.* 2. For $1^d\ 12^h\ 27^m$, *&c.* r. $1^d\ 18^h\ 27^m$, *&c.*

P. 127. L. 7. *b.* *Col.* laſt. For ♉ $16°\ 6'\ 29''$, r. ♉ $14°\ 37'\ 27''$.
P. 146. L. 11. *Col.* laſt. For 44 Yrs bef. Chr. r. 45 Yrs bef. Chr.
L. 1. *b.* For, from 4713, r. from 4714.
P. 147. L. 4. For 4713 Year Jul. Period, r. 4714, *&c.*
L. 5. For Dif. 2954, r. Dif. 2955.
P. 165. L. 10. *b.* For diviſible by 4, r. diviſible by 2.
P. 170. L. 16. *Col.* 1. For *requires*, r. *require.*
P. 172. L. 16. *Col.* 2. For Years *ſince* Chriſt, r. Years *before* Chriſt.
L. 29. ſame *Col.* For *Periods* ſo happened, r. *Period* ſo happened.
P. 193. L. 1. below the *Tables.* For *correcting* or beginning, r. *commencing* or beginning.
P. 231. L. 18. *b.* *Col.* 2. For, from *Coſine* Declination for 5th Arc, r. from *polar* Diſtance for the 5th Arc, *&c.*
P. 234. L. 29. *Col.* 2. For, To the N°. of Earth's Diameters, r. To the N°. of the Earth's Semi-Diameters.
P. 237. Midd. *Col.* 2. For 1.1287, r. 1.2187.
L. 7. lower. For 3^h,12, r. 3^h,67.
P. 263. L. 1. under Tab. *Col.* 1. For *true* Semi-*Diam.* r. *true Diam.*
P. 281. L. 28. *Col.* 1. For, Middle Latitude be *leſs* than 45°, r. be *greater* than 45°.
L. 29. —— For, if *greater* than 45°, r. if *leſs* than 45°.
P. 297. L. 11. *b.* For, as a Means for the Defect, r. as Amen is *made* for the Defect.
P. 312. L. 9. For 1 Mile in 10 *leſs*, r. 1 Mile in 10 *more.*
P. 317. *Third* of 3d *Col.* *Rule* 2. Diff. Long. $5°\ 54'$ W. r. Dif. Long. $5°\ 14'$ W.
P. 323. L. 3. *Col.* 1. For *Buffin*'s Bay, r. *Baffin*'s Bay.
P. 324. L. 25. *Col.* 2. For, and *ſome Iſlands*, r. and *ſome* other *Iſlands.*
L. 3. *b.* For, From the *Diviſions*, r. From the *Diviſion.*
P. 326. L. 24. For $\left.\begin{matrix}\text{leſs}\\\text{greater}\end{matrix}\right\}$ than 180°. r. $\left.\begin{matrix}\text{leſs}\\\text{greater}\end{matrix}\right\}$ than 90°.
L. 29. *b.* For Rad. = 10, r. Rad. = 1.
P. 328. L. 6. *Col.* 7. For, Sum *and* Dif. r. Sum *or* Dif.
P. 359. L. 12. *b.* For 1,000 to 178725 r. 1000 to 178725.
L. 9. *b.* For 178725, r. 178,725.
L. 5. *b.* For, *at* the ſame Time, r. *in* the ſame Time.
P. 360. L. 5. *b.* For, gravitate *more* towards, *&c.* r. gravitate *more* or *leſs* towards the Sun than the Earth.
L. 3. *b.* After KT — introduce, *by which the Moon is alſo attracted towards the Earth,* in the former Caſe, *&c.*
P. 372. Obſ. 16. For $6^s\ 29°\ 29'$, r. $5^s\ 29°\ 29'$ ☽ à ☉.
P. 376. L. 12. *b.* *Col.* 2. *Page.* For 357,45, r. 356,50.
L. 4. *b.* *Marg.* For 112,26, r. 119,26.
P. 390. *Col.* 8. $3^s\ 16°$ . . for $3°\ 40'\ 21''$, r. $4°\ 40'\ 21''$.
P. 397. L. 18. *Col.* 1. For, Ecliptic *Conj.* r. Ecliptic *Oppoſition.*
L. 18. *Col.* 2. For, Ecliptic *Conj.* r. Ecliptic *Oppoſition.*
L. 21. ſame *Col.* For, Ecliptic $10^m\ 43^s$ Dif. r. $10^m\ 43^s$ Dif. blot *Ecliptic.*
L. 3. For Examp. xi, r. Examp. ix.
L. 10. *b.* For 10 6 41 21, r. 10 7 41 21.

THE Reader is deſired to excuſe and correct what other *Eſcapes, or Inaccuracies,* he finds, unavoidably ariſing, in ſo *large* a *Work,* from *Inattention* either of the *Author* or *Compoſitor*, or Both.

☞ *Any material* Errors *contained, eſcaping our Obſervation, we ſhall be obliged to the Men of* Judgment *and* Critics *to point out. So far from our taking ſuch Notice amiſs, that we hereby offer our Thanks to any, who ſhall be pleaſed to detect our Miſtakes, (paying the* Poſtage *of their Letters, franking them, or publickly informing us) that* TRUTH *(which is our* principal View) *may be* promoted.

THE

ROYAL ASTRONOMER

AND

NAVIGATOR.

A GEOGRAPHICAL TABLE of many *eminent* and *remarkable* PLACES in the WORLD, with their correct temporary Difference of *Meridians* and *Longitudes* from GREENWICH OBSERVATORY; and their correct *Latitudes*.

Places Names.	Dif. Time. After or Bef.				Dif. Longit. East or West.				Latitude North or Sou.			
	h	m	s		°	′	″		°	′	″	
Athens, in *Greece,*	1	35	3	A	23	52	30	E	38	5	0	N
Alexandria, Egypt,	2	1	6	A	30	16	30	E	31	7	0	N
Alexander, Syria,	2	25	20	A	36	20	0	E	36	35	10	N
Aracta, or *Racca,*	2	35	20	A	38	50	0	E	36	1	0	N
Agra, in *Mogul,*	5	6	56	A	76	44	0	E	26	43	0	N
Aleppo, Syria,	2	29	20	A	37	20	0	E	35	45	23	N
Algiers,	0	8	51	A	2	12	45	E	36	49	30	N
Amsterdam,	0	19	56	A	4	59	0	E	52	22	45	N
Antibes,	0	28	34	A	7	8	33	E	43	34	50	N
Avignon,	0	19	14	A	4	48	33	E	43	57	25	N
Babylon, Asia,	2	51	6	A	42	46	30	E	33	0	0	N
Babylon, Egypt, G. Cairo,	2	5	45	A	31	26	15	E	30	2	30	N
Berlin, Prussia,	0	53	50	A	13	27	30	E	52	33	0	N
Balasore, East-Indies,	5	44	0	A	86	0	0	E	21	20	0	N
Bagdad,	2	55	6	A	43	46	30	E	33	21	0	N
Barcelona,	0	8	52	A	2	13	0	E	41	26	0	N
Bayonne,	0	8	19	A	2	4	42	E	43	29	21	N
Brest,	0	18	3	B	4	30	45	W	48	23	0	N
Bologna, Italy,	0	46	28	A	11	37	0	E	44	30	0	N
Buenos Ayres, America,	3	52	20	B	58	5	0	W	34	35	0	S
Bourdeaux,	0	2	19	B	0	34	19	W	44	50	18	N
Bologne, France,	0	6	27	A	1	36	44	E	50	43	31	N
Breslaw, Silesia,	1	8	35	A	17	17	30	E	51	3	0	N
Brussels,	0	17	27	A	4	21	43	E	50	51	0	N
Cape of Good Hope,	1	8	0	A	17	0	0	E	34	15	0	S
Carthagena, America,	5	1	46	B	75	26	0	W	10	26	35	N
Cayann Is. America,	3	51	20	B	57	50	0	W	4	56	0	N
Cadiz, Spain,	0	24	28	B	6	7	0	W	36	33	30	N
Copenhagen, Denmark,	0	51	0	A	12	45	0	E	55	40	45	N
Calais,	0	[illegible]	16	A	[illegible]	49	4	E	50	57	31	N
Cambray,	0	5	55	A	3	13	42	E	50	10	30	N
Cape Verd,	1	8	40	B	17	10	0	W	14	43	0	N
Cologne,	0	38	20	A	7	5	0	E	50	55	0	N
Constantinople,	1	55	34	A	28	53	30	E	41	0	0	N
Cracow,	1	19	20	A	19	50	0	E	50	10	0	N
Dantzick, Poland,	1	15	12	A	18	48	0	E	54	22	0	N
Dunkirk,	0	9	30	A	2	22	23	E	51	2	4	N
Edinburgh,	0	12	21	B	3	5	15	W	55	58	0	N
Florence,	0	45	18	A	11	19	30	E	43	46	30	N
Francfort,	0	34	20	A	8	35	0	E	49	55	0	N
Goa, East-Indies,	4	55	0	A	73	45	0	E	15	31	0	N
Geneva,	0	36	20	A	6	20	0	E	46	12	0	N
GREENWICH Observ.	0	0	0	A	0	0	0		51	28	30	N
Jerusalem,	2	21	20	A	35	20	0	E	31	55	0	N
Ingoldstadt,	0	45	30	A	11	22	30	E	48	46	0	N
Ispahan, Persia,	3	31	20	A	52	50	0	E	32	25	0	N
Kebec, or *Quebec, Cana.*	4	58	12	B	73	33	0	W	46	55	0	N
Lima, Peru,	5	7	18	B	76	49	0	W	12	1	15	S
London,	0	0	20	B	0	5	0	W	51	30	40	N
Lisbon,	0	36	30	B	8	57	30	W	38	42	20	N
Lizard Point,	0	19	0	B	4	45	0	W	49	55	0	N
Landau,	0	32	30	A	8	7	30	E	49	11	40	N
Leipsick,	0	49	20	A	12	20	0	E	51	19	14	N
Lisle, Flanders,	0	12	17	A	3	4	16	E	50	37	50	N
Moscow, Russia,	2	41	20	A	40	20	0	E	55	30	0	N
Marseilles,	0	21	29	A	5	22	15	E	43	17	45	N
Madrid,	0	14	58	B	6	2	10	W	40	25	0	N
Malacca, Indies,	6	48	20	A	102	5	0	E	1	15	50	N
Malta,	0	57	50	A	14	29	30	E	35	54	0	N
Manila, Islands, Indies,	8	1	20	A	110	20	0	E	14	30	0	N
Martinico, West-Indies,	4	3	55	B	60	58	45	W	14	43	9	N
Macao, China,	7	35	5	A	113	46	15	E	22	12	44	N
Mexico, America,	6	54	40	B	103	40	0	W	20	0	0	N
Milan,	0	36	20	A	9	20	0	E	45	25	0	N
Modena,	0	44	50	A	11	12	30	E	44	34	0	N
Montpellier,	0	15	31	A	3	52	44	E	43	36	33	N
Mons,	0	15	49	A	3	57	10	E	50	27	10	N
Munich,	0	46	20	A	11	35	0	E	48	2	0	N
Mentz,	0	24	44	A	6	11	0	E	49	7	5	N
Namur,	0	19	26	A	4	51	37	E	50	28	0	N

GEOGRAPHICAL TABLE Continued

Places Names.	Dif. Time. After or Bef. h	m	s		Dif. Longitude. East or West. °	'	"		Latitude North or Sou. °	'	"	
Nantz,	0	~~24~~	55	A	~~6~~ 1	~~13~~ 44	~~48~~	~~E~~ W	47	13	17	N
Naples,	0	58	40	A	14	40	0	E	40	50	45	N
Nuremberg, Germany,	0	44	16	A	11	4	0	E	49	26	0	N
Nice,	0	29	9	A	7	17	22	E	43	41	54	N
New Orleans,	6	18	35	A	94	38	45	E	29	57	45	N
Olinda, Brasil,	2	10	40	B	35	10	0	W	8	13	0	S
Orleans, France,	0	7	37	A	1	54	22	E	47	54	4	N
Ostend,	0	11	40	A	2	55	2	E	51	13	55	N
Oxford,	0	5	4	B	1	16	0	W	51	45	0	N
PARIS Obſervatory,	0	9	20	A	2	20	0	E	48	50	10	N
Pekin, China,	7	45	30	A	116	22	30	E	39	54	0	N
Petersburg,	2	1	20	A	30	20	0	E	60	0	0	N
Pike of Teneriff,	1	6	11	B	16	32	47	W	28	23	27	N
Porto Bello, America,	5	19	20	B	7 ~~89~~	50	6	W	9	33	5	N
Pondicherry, Indies,	5	20	50	A	80	12	50	E	11	53	47	N
Prague, Bohemia,	0	59	0	A	14	45	0	E	50	4	30	N
Poictiers,	0	1	20	A	0	20	5	E	46	35	0	N
Padua, in *Italy,*	0	47	42	A	11	55	30	E	45	22	26	N
Pike of Azores,	1	52	40	B	28	10	0	W	38	35	0	N
Quitto, City, *America,*	5	11	40	B	77	55	0	W	0	13	17	S
*Quanton,*or*Canton,China*	7	32	13	A	113	3	15	E	23	8	0	N
Quimper,	0	16	30	B	4	7	5	W	47	58	24	N
Rome,	0	49	57	A	12	29	15	E	41	54	0	N
Rochelle,	0	5	3	B	1	15	44	W	46	9	43	N
Rhodes,	0	10	17	A	2	34	20	E	44	21	0	N
Rheims,	0	16	12	A	4	2	53	E	49	14	36	N
Rouen,	0	4	21	A	1	5	20	E	49	26	23	N
St. Malo,	0	8	9	B	2	2	22	W	48	38	59	N
St. Omer,	0	9	0	A	1	14	57	E	50	44	46	N
Siam, Indies,	6	43	20	A	100	50	0	E	14	18	0	N

Places Names.	Dif. Time. After or Bef. h	m	s		Dif. Longit. East or West. °	'	"		Latitude. North or Sou. °	'	"	
Smyrna,	1	49	19	A	27	19	45	E	38	28	7	N
Stockholm,	1	17	40	A	19	25	0	E	59	20	0	N
Straſburg,	0	31	5	A	7	46	18	E	48	34	35	N
Surat,	4	49	20	A	72	20	0	E	21	10	0	N
SHERBURN CASTLE,	0	4	0	B	1	0	0	W	51	39	25	N
Toledo, Spain,	0	12	12	B	3	20	0	W	39	50	0	N
Toulon,	0	23	36	A	5	56	35	E	43	7	24	N
Tripoli, Barbary,	0	52	21	A	13	5	15	E	32	53	40	N
Turin,	0	30	40	A	7	40	0	E	44	50	0	N
Tours,	0	2	45	A	0	41	11	E	47	23	44	N
Torneo, Lapland,	1	36	50	A	24	22	30	E	65	50	50	N
Tolouſe,	0	5	45	A	1	26	13	E	43	35	54	N
TerradelGada,Madaga.	2	58	0	A	44	30	0	E	19	29	0	S
Theſſalonica, Turkey,	1	32	32	A	23	8	0	E	40	41	10	N
Valparis, Chili,	4	49	17	B	72	19	15	W	33	0	19	S
Venice,	0	48	18	A	12	4	30	E	45	25	0	N
Verona,	0	45	14	A	11	18	30	E	45	26	26	N
Verſailles,	0	8	29	A	1	7	10	E	48	48	18	N
Vienna,	1	5	30	A	16	22	30	E	48	12	48	N
UPNOR CASTLE,	0	1	48	A	0	27	0	E	51	26	10	N
Upſal, Sweden,	1	11	0	A	17	45	0	E	59	51	50	N
URANIBURG,	0	51	30	A	12	52	30	E	55	54	15	N
Wirtemburg, Saxony,	0	50	14	A	12	33	30	E	51	43	10	N
Ylo, Peru,	4	44	52	B	71	13	0	W	17	36	15	S
Ypres,	0	11	32	A	3	2	55	E	50	51	5	N

USE *of the foregoing* TABLE.

When it is 12 at Noon, Mean Time, at *Greenwich Obſervatory,* what is the Hour, or Mean Time, at *Porto Bello,* in *America?*

EXAMPLE I.——Againſt *Porto Bello,* in the Table you find the Time is $5^h\ 19^m\ 20^s$ *Before* the Time at *Greenwich.*

Therefore, From $12^h\ 0^m\ 0^s$ at *Greenwich,*
Deduct – – 5 19 20

There remains 6 40 40 Time in the Morning at *Porto Bello,* req[d].

And, in general, you deduct the Time Before from the Time at *Greenwich,* or add it thereto, when the Time is after that at *Greenwich,* for the Time at any *Place required;* and you are to obſerve the *contrary,* when the Time is given at any *Place,* to find the Time at *Greenwich Obſervatory,* in Reference to the former Time and Place.

UNIVERSALLY.—The Difference of Degrees in *Weſt* or *Eaſt* Longitude, between the *Meridians* of two Places, converted into Time, allowing 15° to an Hour, is the Time or Hour at one Place *before* or *after* the Mean Time at another; (the *Weſt* Longitude *before,* and *Eaſt* Longitude *after*) therefore, the *Difference* or Sum of the Times of any two Places from the Time at *Greenwich Obſervatory,* as they are both B or A, or one B, and one A, *Greenwich*-Time (uſing *After* and *Before* to *Greenwich,* inſtead of *Before* and *After* from thence) will be the Time at one Place in Reference to the Time at another.

EXAMPLE II.——*To find the Hour at* Babylon, *or* Grand Cairo, *when it is* 10 *in the Forenoon at* Upnor Caſtle?

From the Time at *Greenwich* { *Upnor Caſtle* $0^h\ 1^m\ 48^s$ A
{ *Grand Cairo* 2 5 45 A

Time at *Upnor Caſtle* B. that at *Grand Cairo,* or Difference 2 3 57 A, at *Grand Cairo,* the Time at *Upnor Caſtle.*
10 0 0 +

Time at *Grand Cairo* – 12 3 57 Afternoon required.

EXAMPLE III.—*To find the Time at* Oxford *when it is Noon at* Rome?

From the Time at *Greenwich* { *Rome* $0^h\ 49^m\ 57^s$ A
{ *Oxford* 0 5 4 B

Time at *Oxford* B. Time at *Rome.* Sum 0 55 1 B —
12 0 0

Time at *Oxford* referred to *Rome* 11 4 59 Forenoon requ[d]: being all the Caſes that can happen.

Mean

Mean Radical PLACES of the SUN, and first Star of *Aries*, from 1652 to 1752, Old STYLE.

Julian Style.	M. Pla. ☉.				M. Pla. Ap. ☉.				M. Pl. 1 * ♈.			
	s	°	′	″	s	°	′	″	s	°	′	″
B. 1652	9	20	36	12	3	6	54	17	0	28	18	56
53	9	20	21	52	3	6	55	18	0	28	19	46
54	9	20	7	32	3	6	56	20	0	28	20	37
55	9	19	53	13	3	6	57	21	0	28	21	27
B. 1656	9	20	38	1	3	6	58	23	0	28	22	18
57	9	20	23	41	3	6	59	24	0	28	23	8
58	9	20	9	21	3	7	0	26	0	28	23	59
59	9	19	55	2	3	7	1	27	0	28	24	49
B. 1660	9	20	39	51	3	7	2	29	0	28	25	40
61	9	20	25	31	3	7	3	30	0	28	26	30
62	9	20	11	11	3	7	4	32	0	28	27	21
63	9	19	56	52	3	7	5	33	0	28	28	11
B. 1664	9	20	41	40	3	7	6	35	0	28	29	2
65	9	20	27	20	3	7	7	36	0	28	29	52
66	9	20	13	0	3	7	8	38	0	28	30	43
67	9	19	58	41	3	7	9	39	0	28	31	33
B. 1668	9	20	43	29	3	7	10	41	0	28	32	24
69	9	20	29	9	3	7	11	42	0	28	33	14
70	9	20	14	49	3	7	12	44	0	28	34	5
71	9	20	0	30	3	7	13	45	0	28	34	55
B. 1672	9	20	45	18	3	7	14	47	0	28	35	46
73	9	20	30	58	3	7	15	48	0	28	36	36
74	9	20	16	38	3	7	16	50	0	28	37	27
75	9	20	2	19	3	7	17	51	0	28	38	17
B. 1676	9	20	47	8	3	7	18	53	0	28	39	8
77	9	20	32	48	3	7	19	54	0	28	39	58
78	9	20	18	28	3	7	20	56	0	28	40	49
79	9	20	4	9	3	7	21	57	0	28	41	39
B. 1680	9	20	48	57	3	7	22	59	0	28	42	30
81	9	20	34	37	3	7	24	0	0	28	43	20
82	9	20	20	17	3	7	25	2	0	28	44	11
83	9	20	5	58	3	7	26	3	0	28	45	1
B. 1684	9	20	50	46	3	7	27	5	0	28	45	52
85	9	20	36	26	3	7	28	6	0	28	46	42
86	9	20	22	6	3	7	29	8	0	28	47	33
87	9	20	7	47	3	7	30	9	0	28	48	23
B. 1688	9	20	52	35	3	7	31	11	0	28	49	14
89	9	20	38	15	3	7	32	12	0	28	50	4
90	9	20	23	55	3	7	33	14	0	28	50	55
91	9	20	9	36	3	7	34	15	0	28	51	45
B. 1692	9	20	54	25	3	7	35	17	0	28	52	36
93	9	20	40	5	3	7	36	18	0	28	53	26
94	9	20	25	45	3	7	37	20	0	28	54	17
95	9	20	11	26	3	7	38	21	0	28	55	7
B. 1696	9	20	56	14	3	7	39	23	0	28	55	58
97	9	20	41	54	3	7	40	24	0	28	56	48
98	9	20	27	34	3	7	41	26	0	28	57	39
99	9	20	13	15	3	7	42	27	0	28	58	29

Julian Style.	M. Pla. ☉.				M. Pla. Ap. ☉.				M. Pl. 1 * ♈.			
	s	°	′	″	s	°	′	″	s	°	′	″
B. 1700	9	20	58	3	3	7	43	29	0	28	59	20
1	9	20	43	43	3	7	44	30	0	29	0	10
2	9	20	29	23	3	7	45	32	0	29	1	1
3	9	20	15	4	3	7	46	33	0	29	1	51
B. 1704	9	20	59	53	3	7	47	35	0	29	2	42
5	9	20	45	33	3	7	48	36	0	29	3	32
6	9	20	31	13	3	7	49	38	0	29	4	23
7	9	20	16	54	3	7	50	39	0	29	5	13
B. 1708	9	21	1	42	3	7	51	41	0	29	6	4
9	9	20	47	22	3	7	52	42	0	29	6	54
10	9	20	33	2	3	7	53	44	0	29	7	45
11	9	20	18	43	3	7	54	45	0	29	8	35
B. 1712	9	21	3	31	3	7	55	47	0	29	9	26
13	9	20	49	11	3	7	56	48	0	29	10	16
14	9	20	34	51	3	7	57	50	0	29	11	7
15	9	20	20	32	3	7	58	51	0	29	11	57
B. 1716	9	21	5	20	3	7	59	53	0	29	12	48
17	9	20	51	0	3	8	0	54	0	29	13	38
18	9	20	36	40	3	8	1	56	0	29	14	29
19	9	20	22	21	3	8	2	57	0	29	15	19
B. 1720	9	21	7	10	3	8	3	59	0	29	16	10
21	9	20	52	50	3	8	5	0	0	29	17	0
22	9	20	38	30	3	8	6	2	0	29	17	51
23	9	20	24	11	3	8	7	3	0	29	18	41
B. 1724	9	21	8	59	3	8	8	5	0	29	19	32
25	9	20	54	39	3	8	9	6	0	29	20	22
26	9	20	40	19	3	8	10	8	0	29	21	13
27	9	20	26	0	3	8	11	9	0	29	22	3
B. 1728	9	21	10	48	3	8	12	11	0	29	22	54
29	9	20	56	28	3	8	13	12	0	29	23	44
30	9	20	42	8	3	8	14	14	0	29	24	35
31	9	20	27	49	3	8	15	15	0	29	25	25
B. 1732	9	21	12	38	3	8	16	17	0	29	26	16
33	9	20	58	18	3	8	17	18	0	29	27	6
34	9	20	43	58	3	8	18	20	0	29	27	57
35	9	20	29	39	3	8	19	21	0	29	28	47
B. 1736	9	21	14	27	3	8	20	23	0	29	29	38
37	9	21	0	7	3	8	21	24	0	29	30	28
38	9	20	45	47	3	8	22	26	0	29	31	19
39	9	20	31	28	3	8	23	27	0	29	32	9
B. 1740	9	21	16	16	3	8	24	29	0	29	33	0
41	9	21	1	56	3	8	25	30	0	29	33	50
42	9	20	47	36	3	8	26	32	0	29	34	41
43	9	20	33	17	3	8	27	33	0	29	35	31
B. 1744	9	21	18	5	3	8	28	35	0	29	36	22
45	9	21	3	45	3	8	29	36	0	29	37	12
46	9	20	49	25	3	8	30	38	0	29	38	3
47	9	20	35	6	3	8	31	39	0	29	38	53
B. 1748	9	21	19	55	3	8	32	41	0	29	39	44
49	9	21	5	35	3	8	33	42	0	29	40	34
50	9	20	51	15	3	8	34	44	0	29	41	25
51	9	20	36	56	3	8	35	45	0	29	42	15
B. 1752	9	21	21	44	3	8	36	47	0	29	43	6

SOLAR TABLES.

Mean Radical PLACES of the SUN, and first Star of *Aries*, from 1752 to 1852, New STYLE.

Gregorian Style.	M. Pla. ☉.				M. Pl. Ap. ☉.				M. Pla. 1 ✱ ♈.			
	s	°	′	″	s	°	′	″	s	°	′	″
B. 1752	9	10	31	13	3	8	36	45	0	29	43	5
53	9	10	16	53	3	8	37	46	0	29	43	55
54	9	10	2	33	3	8	38	48	0	29	44	46
55	9	9	48	14	3	8	39	49	0	29	45	36
B. 1756	9	10	33	2	3	8	40	51	0	29	46	27
57	9	10	18	42	3	8	41	52	0	29	47	10
58	9	10	4	22	3	8	42	54	0	29	48	8
59	9	9	50	3	3	8	43	55	0	29	48	58
B. 1760	9	10	34	51	3	8	44	57	0	29	49	49
61	9	10	20	31	3	8	45	58	0	29	50	39
62	9	10	6	11	3	8	47	0	0	29	51	30
63	9	9	51	52	3	8	48	1	0	29	52	20
B. 1764	9	10	36	41	3	8	49	3	0	29	53	11
65	9	10	22	21	3	8	50	4	0	29	54	1
66	9	10	8	1	3	8	51	6	0	29	54	52
67	9	9	53	42	3	8	52	7	0	29	55	42
B. 1768	9	10	38	30	3	8	53	9	0	29	56	33
69	9	10	24	10	3	8	54	10	0	29	57	23
70	9	10	9	50	3	8	55	12	0	29	58	14
71	9	9	55	31	3	8	56	13	0	29	59	4
B. 1772	9	10	40	19	3	8	57	15	0	29	59	55
73	9	10	25	59	3	8	58	16	1	0	0	45
74	9	10	11	39	3	8	59	18	1	0	1	36
75	9	9	57	20	3	9	0	19	1	0	2	26
B. 1776	9	10	42	9	3	9	1	21	1	0	3	17
77	9	10	27	49	3	9	2	22	1	0	4	7
78	9	10	13	29	3	9	3	24	1	0	4	58
79	9	9	59	10	3	9	4	25	1	0	5	48
B. 1780	9	10	43	57	3	9	5	27	1	0	6	39
81	9	10	29	37	3	9	6	28	1	0	7	29
82	9	10	15	17	3	9	7	30	1	0	8	20
83	9	10	0	58	3	9	8	31	1	0	9	10
B. 1784	9	10	45	47	3	9	9	33	1	0	10	1
85	9	10	31	27	3	9	10	34	1	0	10	51
86	9	10	17	7	3	9	11	36	1	0	11	42
87	9	10	2	48	3	9	12	37	1	0	12	32
B. 1788	9	10	47	36	3	9	13	39	1	0	13	23
89	9	10	33	16	3	9	14	40	1	0	14	13
90	9	10	18	56	3	9	15	42	1	0	15	4
91	9	10	4	37	3	9	16	43	1	0	15	54
B. 1792	9	10	49	26	3	9	17	45	1	0	16	45
93	9	10	35	6	3	9	18	46	1	0	17	35
94	9	10	20	46	3	9	19	48	1	0	18	26
95	9	10	6	27	3	9	20	49	1	0	19	16
B. 1796	9	10	51	15	3	9	21	51	1	0	20	7
97	9	10	36	55	3	9	22	52	1	0	20	57
98	9	10	22	35	3	9	23	54	1	0	21	48
99	9	10	8	16	3	9	24	55	1	0	22	38

For Advantage of taking out the Numbers after January *and* February, Bissextile Years *Places are advanced a Day's Motion, in both Styles, correspondent to the mean Noon of* January *the 1st.*

Gregorian Style.	M. Pla. ☉.				M. Pl. Ap. ☉.				M. Pla. 1 ✱ ♈.			
	s	°	′	″	s	°	′	″	s	°	′	″
1800	9	9	53	55	3	9	25	57	1	0	23	29
1	9	9	39	35	3	9	26	58	1	0	24	19
2	9	9	25	15	3	9	28	0	1	0	25	10
3	9	9	10	56	3	9	29	1	1	0	26	0
B. 1804	9	9	55	44	3	9	30	3	1	0	26	51
5	9	9	41	24	3	9	31	4	1	0	27	41
6	9	9	27	4	3	9	32	6	1	0	28	32
7	9	9	12	45	3	9	33	7	1	0	29	22
B. 1808	9	9	57	33	3	9	34	9	1	0	30	13
9	9	9	43	13	3	9	35	10	1	0	31	3
10	9	9	28	53	3	9	36	12	1	0	31	54
11	9	9	14	34	3	9	37	13	1	0	32	44
B. 1812	9	9	59	23	3	9	38	15	1	0	33	35
13	9	9	45	3	3	9	39	16	1	0	34	25
14	9	9	30	43	3	9	40	18	1	0	35	16
15	9	9	16	24	3	9	41	19	1	0	36	6
B. 1816	9	10	1	12	3	9	42	21	1	0	36	57
17	9	9	46	52	3	9	43	22	1	0	37	47
18	9	9	32	32	3	9	44	24	1	0	38	38
19	9	9	18	13	3	9	45	25	1	0	39	28
B. 1820	9	10	3	1	3	9	46	27	1	0	40	19
21	9	9	48	41	3	9	47	28	1	0	41	9
22	9	9	34	21	3	9	48	30	1	0	42	0
23	9	9	20	2	3	9	49	31	1	0	42	50
B. 1824	9	10	4	51	3	9	50	33	1	0	43	41
25	9	9	50	31	3	9	51	34	1	0	44	31
26	9	9	36	11	3	9	52	36	1	0	45	22
27	9	9	21	52	3	9	53	37	1	0	46	12
B. 1828	9	10	6	40	3	9	54	39	1	0	47	3
29	9	9	52	20	3	9	55	40	1	0	47	53
30	9	9	38	0	3	9	56	42	1	0	48	44
31	9	9	23	41	3	9	57	43	1	0	49	34
B. 1832	9	10	8	29	3	9	58	45	1	0	50	25
33	9	9	54	9	3	9	59	46	1	0	51	15
34	9	9	39	49	3	10	0	48	1	0	52	6
35	9	9	25	30	3	10	1	49	1	0	52	56
B. 1836	9	10	10	10	3	10	2	51	1	0	53	47
37	9	9	55	58	3	10	3	52	1	0	54	37
38	9	9	41	38	3	10	4	54	1	0	55	28
39	9	9	27	19	3	10	5	55	1	0	56	18
B. 1840	9	10	12	7	3	10	6	57	1	0	57	9
41	9	9	57	47	3	10	7	58	1	0	57	59
42	9	9	43	27	3	10	9	0	1	0	58	50
43	9	9	29	8	3	10	10	1	1	0	59	40
B. 1844	9	10	13	57	3	10	11	3	1	1	0	31
45	9	9	59	37	3	10	12	4	1	1	1	21
46	9	9	45	17	3	10	13	6	1	1	2	12
47	9	9	30	58	3	10	14	7	1	1	3	2
B. 1848	9	10	15	46	3	10	15	9	1	1	3	53
49	9	10	1	26	3	10	16	10	1	1	4	43
50	9	9	47	6	3	10	17	12	1	1	5	34
51	9	9	32	47	3	10	18	13	1	1	6	24
B. 1852	9	10	17	36	3	10	19	15	1	1	7	15

Mean MOTIONS of the SUN and *fixed* STARS for MONTHS and DAYS.

Days.	JANUARY. M. Mot. ☉ (s ° ′ ″)	Ap. ″	✱s. ″	FEBRUARY. M. Mot. ☉ (s ° ′ ″)	Ap. ″	✱s. ″
1	0 0 59 8	0	0	1 1 32 27	5	4
2	0 1 58 17	0	0	1 2 31 35	5	4
3	0 2 57 25	0	0	1 3 30 43	6	5
4	0 3 56 33	1	0	1 4 29 52	6	5
5	0 4 55 42	1	1	1 5 29 0	6	5
6	0 5 54 50	1	1	1 6 28 8	6	5
7	0 6 53 58	1	1	1 7 27 17	6	5
8	0 7 53 7	1	1	1 8 26 25	6	5
9	0 8 52 15	1	1	1 9 25 33	7	5
10	0 9 51 23	2	1	1 10 24 42	7	6
11	0 10 50 32	2	1	1 11 23 50	7	6
12	0 11 49 40	2	2	1 12 22 58	7	6
13	0 12 48 48	2	2	1 13 22 7	7	6
14	0 13 47 57	2	2	1 14 21 15	7	6
15	0 14 47 5	2	2	1 15 20 23	8	6
16	0 15 46 13	3	2	1 16 19 32	8	6
17	0 16 45 22	3	2	1 17 18 40	8	7
18	0 17 44 30	3	2	1 18 17 48	8	7
19	0 18 43 38	3	3	1 19 16 57	8	7
20	0 19 42 47	3	3	1 20 16 5	8	7
21	0 20 41 55	3	3	1 21 15 13	9	7
22	0 21 41 3	4	3	1 22 14 22	9	7
23	0 22 40 12	4	3	1 23 13 30	9	7
24	0 23 39 20	4	3	1 24 12 38	9	8
25	0 24 38 28	4	3	1 25 11 47	9	8
26	0 25 37 37	4	4	1 26 10 55	9	8
27	0 26 36 45	4	4	1 27 10 3	10	8
28	0 27 35 53	5	4	1 28 9 11	10	8
29	0 28 35 2	5	4	In Leap-Year for *Jan.* & *Feb.* take out for a Day sooner, both Styles.		
30	0 29 34 10	5	4			
31	1 0 33 18	5	4			

Days.	MARCH. M. Mot. ☉ (s ° ′ ″)	Ap. ″	✱s. ″	APRIL. M. Mot. ☉ (s ° ′ ″)	Ap. ″	✱s. ″
1	1 29 8 19	10	8	2 29 41 38	15	12
2	2 0 7 28	10	8	3 0 40 47	15	13
3	2 1 6 36	10	8	3 1 39 55	16	13
4	2 2 5 45	10	9	3 2 39 3	16	13
5	2 3 4 53	11	9	3 3 38 11	16	13
6	2 4 4 1	11	9	3 4 37 20	16	13
7	2 5 3 10	11	9	3 5 36 28	16	13
8	2 6 2 18	11	9	3 6 35 36	16	13
9	2 7 1 26	11	9	3 7 34 45	17	14
10	2 8 0 35	12	9	3 8 33 53	17	14
11	2 8 59 43	12	10	3 9 33 1	17	14
12	2 9 58 51	12	10	3 10 32 10	17	14
13	2 10 58 0	12	10	3 11 31 18	17	14
14	2 11 57 8	12	10	3 12 30 26	17	14
15	2 12 56 16	12	10	3 13 29 34	18	14
16	2 13 55 25	13	10	3 14 28 43	18	15
17	2 14 54 33	13	10	3 15 27 51	18	15
18	2 15 53 41	13	11	3 16 27 0	18	15
19	2 16 52 50	13	11	3 17 26 8	18	15
20	2 17 51 58	13	11	3 18 25 16	18	15
21	2 18 51 6	13	11	3 19 24 25	19	15
22	2 19 50 14	14	11	3 20 23 33	19	15
23	2 20 49 23	14	11	3 21 22 41	19	16
24	2 21 48 31	14	11	3 22 21 50	19	16
25	2 22 47 40	14	12	3 23 20 58	19	16
26	2 23 46 48	14	12	3 24 20 6	19	16
27	2 24 45 56	14	12	3 25 19 15	20	16
28	2 25 45 5	15	12	3 26 18 23	20	16
29	2 26 44 13	15	12	3 27 17 31	20	16
30	2 27 43 21	15	12	3 28 16 40	20	16
31	2 28 42 30	15	12			

To find the Mean Place *of the* Sun, *his* Apogee, *and of the* 1 ✱ ♈, *on* March, 27, 1758, *at Noon,* New Style.

EXAMPLE I.

	☉ s	°	′	″	Ap. ☉ s	°	′	″	1 ✱ ♈ s	°	′	″
N. S. Year 1758.	9	10	4	22	3	8	42	54	0	29	48	8
March 27	2	24	45	56			+	14			+	12
Answer –	0	4	50	18	3	8	43	8	0	29	48	20

To find the Mean Place *of the* Sun, Apogee, *and* 1 ✱ ♈ *on* January 20, 1852, *at Noon,* Gregorian Style.

EXAMPLE II.

	s	°	′	″	s	°	′	″	s	°	′	″
N. S. Year 1852	9	10	17	36	3	10	19	15	1	1	7	15
B. January 19	0	18	43	38			+	3			+	3
Answer –	9	29	1	14	3	10	19	18	1	1	7	18

Mean

Mean MOTIONS of the SUN and *fixed* STARS for MONTHS and DAYS.

Days.	MAY. M. Mot. ☉. s ° ′ ″	Ap. ″	✱s. ″	JUNE. M. Mot. ☉. s ° ′ ″	Ap. ″	✱s. ″	JULY. M. Mot. ☉. s ° ′ ″	Ap. ″	✱s. ″	AUGUST. M. Mot. ☉. s ° ′ ″	Ap. ″	✱s. ″
1	3 29 15 48	20	17	4 29 49 6	25	21	5 29 23 16	31	25	6 29 56 34	36	29
2	4 0 14 56	20	17	5 0 48 15	26	21	6 0 22 24	31	25	7 0 55 42	36	29
3	4 1 14 5	21	17	5 1 47 23	26	21	6 1 21 33	31	25	7 1 54 51	36	30
4	4 2 13 13	21	17	5 2 46 31	26	21	6 2 20 41	31	25	7 2 53 59	36	30
5	4 3 12 21	21	17	5 3 45 39	26	21	6 3 19 49	31	26	7 3 53 7	36	30
6	4 4 11 30	21	17	5 4 44 48	26	22	6 4 18 58	31	26	7 4 52 16	37	30
7	4 5 10 38	21	17	5 5 43 56	26	22	6 5 18 6	32	26	7 5 51 24	37	30
8	4 6 9 46	21	18	5 6 43 4	27	22	6 6 17 14	32	26	7 6 50 32	37	30
9	4 7 8 55	22	18	5 7 42 13	27	22	6 7 16 22	32	26	7 7 49 41	37	30
10	4 8 8 3	22	18	5 8 41 21	27	22	6 8 15 31	32	26	7 8 48 49	37	31
11	4 9 7 11	22	18	5 9 40 29	27	22	6 9 14 39	32	26	7 9 47 57	37	31
12	4 10 6 20	22	18	5 10 39 38	27	22	6 10 13 47	32	27	7 10 47 6	38	31
13	4 11 5 28	22	18	5 11 38 46	27	23	6 11 12 56	33	27	7 11 46 14	38	31
14	4 12 4 36	22	18	5 12 37 55	28	23	6 12 12 4	33	27	7 12 45 22	38	31
15	4 13 3 45	23	19	5 13 37 3	28	23	6 13 11 12	33	27	7 13 44 31	38	31
16	4 14 2 53	23	19	5 14 36 11	28	23	6 14 10 21	33	27	7 14 43 39	38	31
17	4 15 2 1	23	19	5 15 35 20	28	23	6 15 9 29	33	27	7 15 42 47	38	32
18	4 16 1 10	23	19	5 16 34 28	28	23	6 16 8 37	33	27	7 16 41 56	39	32
19	4 17 0 18	23	19	5 17 33 36	28	23	6 17 7 46	34	28	7 17 41 4	39	32
20	4 17 59 26	23	19	5 18 32 45	29	24	6 18 6 54	34	28	7 18 40 12	39	32
21	4 18 58 35	24	19	5 19 31 53	29	24	6 19 6 2	34	28	7 19 39 21	39	32
22	4 19 57 43	24	20	5 20 31 1	29	24	6 20 5 11	34	28	7 20 38 29	39	32
23	4 20 56 51	24	20	5 21 30 10	29	24	6 21 4 19	34	28	7 21 37 37	39	32
24	4 21 56 0	24	20	5 22 29 18	29	24	6 22 3 28	34	28	7 22 36 46	40	33
25	4 22 55 8	24	20	5 23 28 26	30	24	6 23 2 36	35	28	7 23 35 54	40	33
26	4 23 54 16	24	20	5 24 27 35	30	24	6 24 1 44	35	29	7 24 35 2	40	33
27	4 24 53 25	25	20	5 25 26 43	30	25	6 25 0 52	35	29	7 25 34 11	40	33
28	4 25 52 33	25	20	5 26 25 51	30	25	6 26 0 1	35	29	7 26 33 19	40	33
29	4 26 51 41	25	20	5 27 25 0	30	25	6 26 59 9	35	29	7 27 32 27	40	33
30	4 27 50 50	25	21	5 28 24 8	30	25	6 27 58 17	35	29	7 28 31 36	41	33
31	4 28 49 58	25	21				6 28 57 26	36	29	7 29 30 44	41	33

To find the Mean Place *of the* Sun, *his* Apogee, *and* 1✱♈, *on* March 16, 1758, *at Noon, Old Style.*

EXAMPLE III.

	☉ s ° ′ ″	Ap. ☉ s ° ′ ″	1✱♈ s ° ′ ″
O. S. Year 1658	9 20 9 21	3 7 0 26	0 28 23 59
Motion Years 100	45 32	1 42 30	1 24 10
16 March	2 13 55 25	13	10
O. S. 16th March 1758.	0 4 50 18	3 8 43 9	0 29 48 19

To find the Mean Place *of the* Sun, Apogee, *and* 1✱♈, *on* January 8, 1852, *at Noon,* O. S.

EXAMPLE IV.

	☉ s ° ′ ″	Ap. ☉ s ° ′ ″	1✱♈ s ° ′ ″
O. S. Year 1752	9 21 21 44	3 8 36 47	0 29 43 6
Motion Years 100	45 32	1 42 30	1 24 10
B. 7th January	0 6 53 58	1	1
O. S. 8th Jan. 1852	9 29 1 14	3 10 19 18	1 1 7 17

Being a complete Proof of the Truth of the Tables, from what is done on the other Side.

Mean

Mean MOTIONS of the SUN, and *Fixed* STARS, for MONTHS and DAYS.

Days.	SEPTEMBER. M. Mot. ☉.	Ap.	∗s.	OCTOBER. M. Mot. ☉.	Ap.	∗s.	NOVEMBER. M. Mot. ☉.	Ap.	∗s.	DECEMBER. M. Mot. ☉.	Ap.	∗s.
	s ° ′ ″	″	″	s ° ′ ″	″	″	s ° ′ ″	″	″	s ° ′ ″	″	″
1	8 0 29 52	41	34	9 0 4 2	46	38	10 0 37 20	51	42	11 0 11 30	56	46
2	8 1 29 1	41	34	9 1 3 10	46	38	10 1 36 29	51	42	11 1 10 38	56	46
3	8 2 28 9	41	34	9 2 2 19	46	38	10 2 35 37	52	42	11 2 9 47	57	46
4	8 3 27 17	41	34	9 3 1 27	47	38	10 3 34 45	52	42	11 3 8 55	57	47
5	8 4 26 26	42	34	9 4 0 35	47	38	10 4 33 54	52	42	11 4 8 3	57	47
6	8 5 25 34	42	34	9 4 59 44	47	38	10 5 33 2	52	43	11 5 7 12	57	47
7	8 6 24 42	42	34	9 5 58 52	47	39	10 6 32 10	52	43	11 6 6 20	57	47
8	8 7 23 51	42	35	9 6 58 0	47	39	10 7 31 19	52	43	11 7 5 28	57	47
9	8 8 22 59	42	35	9 7 57 8	47	39	10 8 30 27	53	43	11 8 4 37	58	47
10	8 9 22 7	42	35	9 8 56 17	48	39	10 9 29 35	53	43	11 9 3 45	58	47
11	8 10 21 16	43	35	9 9 55 25	48	39	10 10 28 44	53	43	11 10 2 53	58	48
12	8 11 20 24	43	35	9 10 54 34	48	39	10 11 27 52	53	44	11 11 2 2	58	48
13	8 12 19 32	43	35	9 11 53 42	48	39	10 12 27 0	53	44	11 12 1 10	58	48
14	8 13 18 41	43	35	9 12 52 50	48	40	10 13 26 9	53	44	11 13 0 18	58	48
15	8 14 17 49	43	36	9 13 51 59	48	40	10 14 25 17	54	44	11 13 59 27	59	48
16	8 15 16 57	43	36	9 14 51 7	49	40	10 15 24 25	54	44	11 14 58 35	59	48
17	8 16 16 5	44	36	9 15 50 15	49	40	10 16 23 34	54	44	11 15 57 43	59	48
18	8 17 15 14	44	36	9 16 49 24	49	40	10 17 22 42	54	44	11 16 56 52	59	49
19	8 18 14 22	44	36	9 17 48 32	49	40	10 18 21 50	54	45	11 17 56 0	59	49
20	8 19 13 30	44	36	9 18 47 40	49	40	10 19 20 59	54	45	11 18 55 8	59	49
21	8 20 12 39	44	36	9 19 46 49	49	41	10 20 20 7	55	45	11 19 54 17	60	49
22	8 21 11 47	45	37	9 20 45 57	50	41	10 21 19 15	55	45	11 20 53 25	60	49
23	8 22 10 55	45	37	9 21 45 5	50	41	10 22 18 24	55	45	11 21 52 33	60	49
24	8 23 10 4	45	37	9 22 44 14	50	41	10 23 17 32	55	45	11 22 51 42	60	49
25	8 24 9 12	45	37	9 23 43 22	50	41	10 24 16 40	55	45	11 23 50 50	60	50
26	8 25 8 20	45	37	9 24 42 30	50	41	10 25 15 49	55	46	11 24 49 58	60	50
27	8 26 7 29	45	37	9 25 41 39	50	41	10 26 14 57	56	46	11 25 49 7	60	50
28	8 27 6 37	46	37	9 26 40 47	51	41	10 27 14 5	56	46	11 26 48 15	61	50
29	8 28 5 45	46	37	9 27 39 55	51	42	10 28 13 13	56	46	11 27 47 23	61	50
30	8 29 4 54	46	38	9 28 39 4	51	42	10 29 12 22	56	46	11 28 46 32	61	50
31				9 29 38 12	51	42				11 29 45 40	61	50

RADICAL MEAN PLACES and MOTIONS of the SUN, from ſeveral AUTHORITIES.

M. Pl. ☉. Julian Style. Jan. 0. 1701.	M. Pl. Ap. ☉. Julian Style. Jan. 0. 1701.	M. Mot. ☉. in 100 Julian Years.	M. Mot. Ap. in 100 Julian Years.	1 mean Solar Year, 365 Days.	Eccentry to M. Diſt. 100000.	Greateſt Eqn. ⊖ Orb.	According to
s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″	h m s th		s ° ′ ″	
9 20 43 40	3 7 44 30	0 0 45 20 100 Revols.	0 1 41 0 Ap. à ∗s 17 40	5 48 57 41 &c.	1692	0 1 56 20	Sir *Iſaac Newton*'s laſt Edit. *Principia* 1°. 23′. 20″. ∗s à Eqx in 100 J. Yrs.
9 20 43 33 9 20 43 53	3 7 39 10 3 7 46 30	0 0 45 32 Same [20‴	0 1 41 7 Same [20‴	5 48 54 41 &c.	ſame	ſame . . . . . ☞	Dr. *Ed. Halley*'s Tables, 1701, 1 ∗ ♈ *Gael Morris* Aſt Aſt R. [0s. 29°. 0′. 10″.
9 20 43 35	3 7 45 30	0 0 45 47	0 1 45 0 ∗0 1 24 20	5 48 51 7 or Eqx Præcn	1680	0 1 55 30	*Tobias Mayer*, of *Gottingen*, *Germany*, from his Tables.
9 20 41 31	3 8 5 41	0 0 46 0	0 1 25 50	5 48 47 57 &c.	1676	0 1 55 15	*Leonard Euler*, of *Berlin*, *Pruſſia*, F. R. S. from his Tables.
9 20 40 21	3 7 16 0	0 0 43 25	0 1 20 0	5 49 25 41 &c.	1732	0 1 59 6	*Thomas Street*'s Caroline Tables.
9 20 43 43	3 7 44 30	0 0 45 32	0 1 42 30 ∗0 1 24 10	5 48 54 46 &c.	1685	0 1 55 50	Our own Tables.

Hence, From a *Compariſon* of Theſe, with other *Obſervations*, we give the following correct

Radical Mean Places and Motions of the Sun, his Apogee, and of the Fixed Stars, for *Julian* and *Gregorian* Years.

Julian Style. Years before and since Christ.	M. Places ☉. s	°	'	''	M.Pl.Ap.☉. s	°	'	''	M. Pl. 1 *♈. s	°	'	''
B. 1000	9	0	28	39	1	21	35	59	11	21	6	50
B. 900	9	1	14	11	1	23	18	29	11	22	31	0
B. 800	9	1	59	43	1	25	0	59	11	23	55	10
B. 700	9	2	45	15	1	26	43	29	11	25	19	20
B. 600	9	3	30	47	1	28	25	59	11	20	43	30
B. 500	9	4	16	19	2	0	8	29	11	28	7	40
B. 400	9	5	1	51	2	1	50	59	11	29	31	50
B. 300	9	5	47	23	2	3	33	29	0	0	56	0
B. 200	9	6	32	55	2	5	15	59	0	2	20	10
B. Jul. Period. 100	9	7	18	27	2	6	58	29	0	3	44	20
B. 4713. B Chr. 0	9	8	3	59	2	8	40	59	0	5	8	30
B. 100	9	8	49	31	2	10	23	29	0	6	32	40
B. 200	9	9	35	3	2	12	5	59	0	7	56	50
B. 300	9	10	20	35	2	13	48	29	0	9	21	0
B. 400	9	11	6	7	2	15	30	59	0	10	45	10
B. 500	9	11	51	39	2	17	13	29	0	12	9	20
B. 600	9	12	37	11	2	18	55	59	0	13	33	30
B. 700	9	13	22	43	2	20	38	29	0	14	57	40
B. 800	9	14	8	15	2	22	20	59	0	16	21	50
B. 900	9	14	53	47	2	24	3	29	0	17	46	0
B. 1000	9	15	39	19	2	25	45	59	0	19	10	10
B. 1100	9	16	24	51	2	27	28	29	0	20	34	20
B. 1200	9	17	10	23	2	29	10	59	0	21	58	30
B. 1300	9	17	55	55	3	0	53	29	0	23	22	40
B. 1400	9	18	41	27	3	2	35	59	0	24	46	50
B. 1500	9	19	26	59	3	4	18	29	0	26	11	0
B. 1600	9	20	12	31	3	6	0	59	0	27	35	10
B. 1700	9	20	58	3	3	7	43	29	0	28	59	20
B. 1800	9	21	43	35	3	9	25	59	1	0	23	30
B. 1900	9	22	29	7	3	11	8	29	1	1	47	40
B. 2000	9	23	14	39	3	12	50	59	1	3	11	50

Bissextile Years Places are advanced a Day's Motion.

Gregorian Style. Years of Christ.	M. Places ☉. s	°	'	''	M.Pl.Ap.☉. s	°	'	''	M. Pl. 1 *♈. s	°	'	''
B. 1600	9	10	21	8	3	6	0	57	0	27	35	9
1700	9	10	7	32	3	7	43	27	0	28	59	19
1800	9	9	53	55	3	9	25	57	1	0	23	28
1900	9	9	40	19	3	11	8	27	1	1	47	38
B. 2000	9	10	25	51	3	12	50	57	1	3	11	48
2100	9	10	12	15	3	14	33	27	1	4	35	58
2200	9	9	58	38	3	16	15	57	1	6	0	8
2300	9	9	45	2	3	17	58	27	1	7	24	18
B. 2400	9	10	30	34	3	19	40	56	1	8	48	28
2500	9	10	16	58	3	21	23	26	1	10	12	38
2600	9	10	3	21	3	23	5	56	1	11	36	48
2700	9	9	49	45	3	24	48	26	1	13	0	57
B. 2800	9	10	35	17	3	26	30	56	1	14	25	7
2900	9	10	21	41	3	28	13	26	1	15	49	17
3000	9	10	8	4	3	29	55	56	1	17	13	27
3100	9	9	54	28	4	1	38	25	1	18	37	37
B. 3200	9	10	40	0	4	3	20	55	1	20	1	47
3300	9	10	26	24	4	5	3	25	1	21	25	57
3400	9	10	12	47	4	6	45	55	1	22	50	7

Bissextile Years Places are advanced a Day's Motion.

From Hundreds of Years *Gregorian* deduct their *Fourth* (rejecting Fractions) and the *Remainder* will be equal to the N°. of Days there are *less* in any N°. of *Gregorian* Years than there are in the same N°. of Years *Julian*, from 1600. Whence is had the Diff. of Motion between *Julian* and *Gregorian* Years.

EXAMPLES.

In the Year 3200.	In the Year 3756
—1600	1600
¼ 16|00	¼ 21|56
— 4	— 5
12 Days less [than in 16 Hund. Yrs *Jul.*	16 Days less than in 21 [Hundred Years *Julian*.

Julian Years.	M. Mot. ☉. s	°	'	''	Mean Mot. Ap. ☉. s	°	'	''	Mean Mot. fixed Stars. s	°	'	''
B. 100	0	0	45	32	0	1	42	30	0	1	24	10
B. 200	0	1	31	4	0	3	25	0	0	2	48	20
B. 300	0	2	16	36	0	5	7	30	0	4	12	30
B. 400	0	3	2	8	0	6	50	0	0	5	36	40
B. 500	0	3	47	40	0	8	32	30	0	7	0	50
B. 600	0	4	33	12	0	10	15	0	0	8	25	0
B. 700	0	5	18	44	0	11	57	30	0	9	49	10
B. 800	0	6	4	16	0	13	40	0	0	11	13	20
B. 900	0	6	49	48	0	15	22	30	0	12	37	30
B. 1000	0	7	35	20	0	17	5	0	0	14	1	40
B. 2000	0	15	10	40	1	4	10	0	0	28	3	20
B. 3000	0	22	46	0	1	21	15	0	1	12	5	0
B. 4000	1	0	21	20	2	8	20	0	1	26	6	40
B. 5000	1	7	56	40	2	25	25	0	2	10	8	20
B. 6000	1	15	32	0	3	12	30	0	2	24	10	0

Gregorian Years from 1600	M. Mot. ☉. s	°	'	''	Mean Mot. Ap. ☉. s	°	'	''	Mean Mot. fixed Stars. s	°	'	''
100	11	29	46	24	0	1	42	30	0	1	24	10
200	11	29	32	47	0	3	25	0	0	2	48	20
300	11	29	19	11	0	5	7	30	0	4	12	30
B. 400	0	0	4	43	0	6	50	0	0	5	36	40
B. 800	0	0	9	26	0	13	39	59	0	11	13	19
B. 1200	0	0	14	9	0	20	29	59	0	16	49	59
B. 1600	0	0	18	52	0	27	19	58	0	22	26	38
B. 2000	0	0	23	35	1	4	9	58	0	28	3	18
B. 2400	0	0	28	18	1	10	59	57	1	3	39	58
B. 2800	0	0	33	1	1	17	49	57	1	9	16	37
B. 3200	0	0	37	44	1	24	39	56	1	14	53	17
B. 3600	0	0	42	27	2	1	29	56	1	20	29	56
B. 4000	0	0	47	10	2	8	19	55	1	26	6	30
B. 6000	0	1	10	45	3	12	29	53	2	24	9	54

Mean MOTION of the SUN, and of the FIXED STARS, for 99 Julian YEARS.

Julian Years.	M. Mot. ☉.	Comp.	Mot. ☉ Apogee.	Mean Mot. fixed Stars.
	s ° ′ ″	′ ″	° ′ ″	s ° ′ ″
1	11 29 45 40	14 20	1 1	0 50
2	11 29 31 20	28 40	2 3	1 41
3	11 29 17 1	42 59	3 4	2 31
B. 4	0 0 1 49		4 6	3 22
5	11 29 47 29	12 31	5 7	4 12
6	11 29 33 10	26 50	6 9	5 3
7	11 29 18 50	41 10	7 10	5 53
B. 8	0 0 3 39		8 12	6 44
9	11 29 49 19	10 41	9 13	7 34
10	11 29 34 59	25 1	10 15	8 25
11	11 29 20 39	39 21	11 16	9 15
B. 12	0 0 5 28		12 18	10 6
13	11 29 51 8	8 52	13 19	10 56
14	11 29 36 48	23 12	14 21	11 47
15	11 29 22 29	37 31	15 22	12 37
B. 16	0 0 7 17		16 24	13 28
17	11 29 52 57	7 3	17 25	14 18
18	11 29 38 38	21 22	18 27	15 9
19	11 29 24 18	35 42	19 28	15 59
B. 20	0 0 9 6		20 30	16 50
21	11 29 54 46	5 14	21 31	17 40
22	11 29 40 26	19 34	22 33	18 30
23	11 29 26 7	33 53	23 34	19 21
B. 24	0 0 10 56		24 36	20 12
25	11 29 56 36	3 24	25 37	21 2
26	11 29 42 16	17 44	26 39	21 53
27	11 29 27 57	32 3	27 40	22 43
B. 28	0 0 12 45		28 42	23 34
29	11 29 58 25	1 35	29 43	24 24
30	11 29 44 5	15 55	30 45	25 15
31	11 29 29 46	30 14	31 46	26 5
B. 32	0 0 14 34		32 48	26 56
33	0 0 0 14		33 49	27 46
34	11 29 45 54	14 6	34 51	28 37
35	11 29 31 35	28 25	35 52	29 27
B. 36	0 0 16 24		36 54	30 18
37	0 0 2 4		37 55	31 8
38	11 29 47 44	12 16	38 57	31 59
39	11 29 33 25	26 35	39 58	32 49
B. 40	0 0 18 13		41 0	33 40
41	0 0 3 53		42 1	34 30
42	11 29 49 33	10 27	43 3	35 21
43	11 29 35 14	24 46	44 4	36 11
B. 44	0 0 20 2		45 6	37 2
45	0 0 5 42		46 7	37 52
46	11 29 51 22	8 38	47 9	38 43
47	11 29 37 3	22 57	48 10	39 33
B. 48	0 0 21 51		49 12	40 24

Connect these Motions with Places for whole Hundreds, in either Style, for the present Year's Places.

Julian Years.	M. Mot. ☉.	Comp.	Mot. ☉ Apogee.	Mean Mot. fixed Stars.
	s ° ′ ″	′ ″	° ′ ″	s ° ′ ″
49	0 0 7 31		50 13	41 14
50	11 29 53 11	6 49	51 15	42 5
51	11 29 38 52	21 8	52 16	42 55
B. 52	0 0 23 41		53 18	43 46
53	0 0 9 21		54 19	44 36
54	11 29 55 1	4 59	55 21	45 27
55	11 29 40 42	19 18	56 22	46 17
B. 56	0 0 25 30		57 24	47 8
57	0 0 11 10		58 25	47 58
58	11 29 56 50	3 10	59 27	48 49
59	11 29 42 31	17 29	1 0 28	49 39
B. 60	0 0 27 19		1 1 30	50 30
61	0 0 12 59		1 2 31	51 20
62	11 29 58 39	1 21	1 3 33	52 11
63	11 29 44 20	15 40	1 4 34	53 1
B. 64	0 0 29 8		1 5 36	53 52
65	0 0 14 48		1 6 37	54 42
66	0 0 0 28		1 7 39	55 33
67	11 29 46 9	13 51	1 8 40	56 23
B. 68	0 0 30 58		1 9 42	57 14
69	0 0 16 38		1 10 43	58 4
70	0 0 2 18		1 11 45	58 55
71	11 29 47 59	12 1	1 12 46	59 45
B. 72	0 0 32 47		1 13 48	1 0 36
73	0 0 18 27		1 14 49	1 1 26
74	0 0 4 7		1 15 51	1 2 17
75	11 29 49 48	10 12	1 16 52	1 3 7
B. 76	0 0 34 36		1 17 54	1 3 58
77	0 0 20 16		1 18 55	1 4 48
78	0 0 5 56		1 19 57	1 5 39
79	11 29 51 37	8 23	1 20 58	1 6 29
B. 80	0 0 36 26		1 22 0	1 7 20
81	0 0 22 6		1 23 1	1 8 10
82	0 0 7 46		1 24 3	1 9 1
83	11 29 53 27	6 33	1 25 4	1 9 51
B. 84	0 0 38 15		1 26 6	1 10 42
85	0 0 23 55		1 27 7	1 11 32
86	0 0 9 35		1 28 9	1 12 23
87	11 29 55 16	4 44	1 29 10	1 13 13
B. 88	0 0 40 4		1 30 12	1 14 4
89	0 0 25 44		1 31 13	1 14 54
90	0 0 11 24		1 32 15	1 15 45
91	11 29 57 5	2 55	1 33 16	1 16 35
B. 92	0 0 41 53		1 34 18	1 17 26
93	0 0 27 33		1 35 19	1 18 16
94	0 0 13 13		1 36 21	1 19 7
95	11 29 58 54	1 6	1 37 22	1 19 57
B. 96	0 0 43 43		1 38 24	1 20 48
97	0 0 29 23		1 39 25	1 21 38
98	0 0 15 3		1 40 27	1 22 29
99	0 0 0 44		1 41 28	1 23 19

Mean PLACES of the SUN and *Fixed* STARS for *Years* and *Months*, *Old* and *New Style*.

1600 Months.	Ds.	Julian Style. Mean Pl. ☉ s	°	′	″	M.Pl.Ap.☉ s	°	′	″	M.Pl.1✱♈ s	°	′	″
January	1	9	20	12	31	3	6	0	59	0	27	35	10
February	1	10	20	45	49	3	6	1	4	0	27	35	14
March	0	11	18	21	42	3	6	1	9	0	27	35	18
April	0	0	18	55	1	3	6	1	14	0	27	35	22
May	0	1	18	29	11	3	6	1	19	0	27	35	27
June	0	2	19	2	29	3	6	1	24	0	27	35	31
July	0	3	18	36	39	3	6	1	29	0	27	35	35
August	0	4	19	9	57	3	6	1	35	0	27	35	39
September	0	5	19	43	15	3	6	1	40	0	27	35	44
October	0	6	19	17	25	3	6	1	45	0	27	35	48
November	0	7	19	50	43	3	6	1	50	0	27	35	52
December	0	8	19	24	53	3	6	1	55	0	27	35	56

1600 Months.	Ds.	Gregorian Style. Mean Pl. ☉ s	°	′	″	M.Pl.Ap.☉ s	°	′	″	M.Pl.1✱♈ s	°	′	″
January	1	9	10	21	8	3	6	0	57	0	27	35	9
February	1	10	10	54	26	3	6	1	2	0	27	35	13
March	0	11	8	30	19	3	6	1	7	0	27	35	17
April	0	0	9	3	38	3	6	1	12	0	27	35	21
May	0	1	8	37	47	3	6	1	17	0	27	35	26
June	0	2	9	11	6	3	6	1	22	0	27	35	30
July	0	3	8	45	16	3	6	1	27	0	27	35	34
August	0	4	9	18	34	3	6	1	33	0	27	35	38
September	0	5	9	51	52	3	6	1	38	0	27	35	43
October	0	6	9	26	2	3	6	1	43	0	27	35	47
November	0	7	9	59	20	3	6	1	48	0	27	35	51
December	0	8	9	33	30	3	6	1	53	0	27	35	55

1700		Julian Style.											
January	1	9	20	58	3	3	7	43	29	0	28	59	20
February	1	10	21	31	21	3	7	43	34	0	28	59	24
March	0	11	19	7	14	3	7	43	39	0	28	59	28
April	0	0	19	40	33	3	7	43	44	0	28	59	32
May	0	1	19	14	43	3	7	43	49	0	28	59	37
June	0	2	19	48	1	3	7	43	54	0	28	59	41
July	0	3	19	22	11	3	7	43	59	0	28	59	45
August	0	4	19	55	29	3	7	44	5	0	28	59	49
September	0	5	20	28	47	3	7	44	10	0	28	59	54
October	0	6	20	2	57	3	7	44	15	0	28	59	58
November	0	7	20	36	15	3	7	44	20	0	29	0	2
December	0	8	20	10	25	3	7	44	25	0	29	0	6

1700		Gregorian Style.											
January	0	9	10	7	32	3	7	43	27	0	28	59	19
February	0	10	10	40	50	3	7	43	32	0	28	59	23
March	0	11	8	16	43	3	7	43	37	0	28	59	27
April	0	0	8	50	2	3	7	43	42	0	28	59	31
May	0	1	8	24	12	3	7	43	47	0	28	59	36
June	0	2	8	57	30	3	7	43	52	0	28	59	40
July	0	3	8	31	40	3	7	43	57	0	28	59	44
August	0	4	9	4	58	3	7	44	3	0	28	59	48
September	0	5	9	38	16	3	7	44	8	0	28	59	53
October	0	6	9	12	26	3	7	44	13	0	28	59	57
November	0	7	9	45	44	3	7	44	18	0	29	0	1
December	0	8	9	19	54	3	7	44	23	0	29	0	5

1800		Julian Style.											
January	1	9	21	43	35	3	9	25	59	1	0	23	30
February	1	10	22	16	53	3	9	26	4	1	0	23	34
March	0	11	19	52	46	3	9	26	9	1	0	23	38
April	0	0	20	26	5	3	9	26	14	1	0	23	42
May	0	1	20	0	15	3	9	26	19	1	0	23	47
June	0	2	20	33	33	3	9	26	24	1	0	23	51
July	0	3	20	7	43	3	9	26	29	1	0	23	55
August	0	4	20	41	1	3	9	26	35	1	0	23	59
September	0	5	21	14	19	3	9	26	40	1	0	24	4
October	0	6	20	48	29	3	9	26	45	1	0	24	8
November	0	7	21	21	47	3	9	26	50	1	0	24	12
December	0	8	20	55	57	3	9	26	55	1	0	24	16

1800		Gregorian Style.											
January	0	9	9	53	55	3	9	25	57	1	0	23	28
February	0	10	10	27	13	3	9	26	2	1	0	23	32
March	0	11	8	3	6	3	9	26	7	1	0	23	36
April	0	0	8	36	25	3	9	26	12	1	0	23	40
May	0	1	8	10	34	3	9	26	17	1	0	23	45
June	0	2	8	43	53	3	9	26	22	1	0	23	49
July	0	3	8	18	3	3	9	26	27	1	0	23	53
August	0	4	8	51	21	3	9	26	33	1	0	23	57
September	0	5	9	24	39	3	9	26	38	1	0	24	2
October	0	6	8	58	49	3	9	26	43	1	0	24	6
November	0	7	9	32	7	3	9	26	48	1	0	24	10
December	0	8	9	6	17	3	9	26	53	1	0	24	14

In Leap-Year take out the Month Day Motions for *January* and *February* 1 Day sooner, in both Styles.

EXAMPLE I.

To find the Place of the Sun, Apogee, and 1✱♈, *for* January 11, 1632, *at Noon, O. S.?*

	☉ s	°	′	″	Ap. ☉ s	°	′	″	1✱♈ s	°	′	″
O.S. Jan. 1. 1600.	9	20	12	31	3	6	0	59	0	27	35	10
Years 32		0	14	34			32	48			26	56
B. Days 10		9	51	23				2				1
O.S. Jan. 11. 1632	10	0	18	28	3	6	33	49	0	28	2	7

EXAMPLE II.

To find the Place of the Sun, Apogee, and 1✱♈ *for* October 29, 1820, *at Noon, N. S.?*

	☉ s	°	′	″	Ap. ☉ s	°	′	″	1✱♈ s	°	′	″
N.S. Oct. 0, 1800	6	8	58	49	3	9	26	43	1	0	24	6
Years 20		0	9	6			20	30			16	50
Days 29		28	35	2				5				4
N.S. Oct. 29, 1820	7	7	42	57	3	9	47	18	1	0	41	0

Mean

Mean MOTION of the SUN, and of the *Fixed Stars*, continued, for Months, Days, &c.

	Mths.	M. Mot. ☉. s	°	′	″	Ap. ″	*s. ″
Ds.	*Jan.* 0	0	0	0	0	0	0
31	*Feb.* 0	1	0	33	18	5	4
59	*March* 0	1	28	9	11	10	8
90	*April* 0	2	28	42	30	15	12
120	*May* 0	3	28	16	40	20	17
151	*June* 0	4	28	49	58	25	21
181	*July* 0	5	28	24	8	30	25
212	*August* 0	6	28	57	26	36	29
243	*Sept.* 0	7	29	30	44	41	34
273	*Oct.* 0	8	29	4	54	46	38
304	*Nov.* 0	9	29	38	12	51	42
334	*Dec.* 0	10	29	12	22	56	46

Take out 1 Day sooner for *January* and *February*, in Leap-year.

Days	s	°	′	″	Ap. ″	*s. ″
1	0	0	59	8	0	0
2	0	1	58	17	0	0
3	0	2	57	25	0	0
4	0	3	56	33	1	0
5	0	4	55	42	1	1
6	0	5	54	50	1	1
7	0	6	53	58	1	1
8	0	7	53	7	1	1
9	0	8	52	15	1	1
10	0	9	51	23	2	1
11	0	10	50	32	2	1
12	0	11	49	40	2	2
13	0	12	48	48	2	2
14	0	13	47	57	2	2
15	0	14	47	5	2	2
16	0	15	46	13	3	2
17	0	16	45	22	3	2
18	0	17	44	30	3	2
19	0	18	43	38	3	3
20	0	19	42	47	3	3
21	0	20	41	55	3	3
22	0	21	41	3	4	3
23	0	22	40	12	4	3
24	0	23	39	20	4	3
25	0	24	38	28	4	3
26	0	25	37	37	4	4
27	0	26	36	45	4	4
28	0	27	35	53	5	4
29	0	28	35	2	5	4
30	0	29	34	10	5	4
31	1	0	33	18	5	4

Chronological Æras before and since Christ.

776	*Olympiads, 4 Years each,* ☽ *after Summer Solstice.*
752	*Building of* Rome, April 21.
746	Nabonassar, February 26.
323	*Death* Alex. the Great, Nov. 12.
45	*Calendar settled by* J. Cæs. Jan. 1.
0	*Birth of Christ.*
284	Dioclesian, August 29.
325	*Council of* Nice.
622	*Hegira of* Turks, July 16.
632	*Jesdegird of* Persians, June 16, *O.S.*
1582	Gregorian *Style began* October
1752	*Began in* England, Sept. 3, *O. S. or* Sept. 14, *N. S.*

H. / Min. / Sec.	M.Mo. ☉ ° / ′ / ″	′ / ″ / ‴	″ / ‴ / iv	H. / Min. / Sec.	M.Mo. ☉ ° / ′ / ″	′ / ″ / ‴	″ / ‴ / iv
1	0	2	28	31	1	16	23
2	0	4	56	32	1	18	51
3	0	7	24	33	1	21	19
4	0	9	51	34	1	23	47
5	0	12	19	35	1	26	14
6	0	14	47	36	1	28	42
7	0	17	15	37	1	31	10
8	0	19	43	38	1	33	38
9	0	22	11	39	1	36	6
10	0	24	38	40	1	38	34
11	0	27	6	41	1	41	1
12	0	29	34	42	1	43	29
13	0	32	2	43	1	45	57
14	0	34	30	44	1	48	25
15	0	36	58	45	1	50	53
16	0	39	26	46	1	53	21
17	0	41	53	47	1	55	48
18	0	44	21	48	1	58	16
19	0	46	49	49	2	0	44
20	0	49	17	50	2	3	12
21	0	51	45	51	2	5	40
22	0	54	13	52	2	8	8
23	0	56	40	53	2	10	36
24	0	59	8	54	2	13	3
25	1	1	36	55	2	15	31
26	1	4	4	56	2	17	59
27	1	6	32	57	2	20	27
28	1	9	0	58	2	22	55
29	1	11	27	59	2	25	23
30	1	13	55	60	2	27	50

EXAMPLE I.

To find the Mean Place of the Sun, his Apogee, and the first *♈, January 20, 1758, *at Noon, New Style?*

	M. Pla ☉. s	°	′	″	Ap. ☉. s	°	′	″	1*♈. s	°	′	″
N. S. 1700	9	10	7	32	3	7	43	27	0	28	59	19
Mo. Yrs 58		—	3	10		+	59	27		+	48	49
Plas. 1758	9	10	4	22	3	8	42	54	0	29	48	8
Mo. Jan. 20	0	19	42	47	+		+	3			+	3
M. Pl. reqd.	9	29	47	9	3	8	42	57	0	29	48	11
					9	29	47	9				
					6	21	4	12	☉ M. Anom.			

EXAMPLE II.

To find the Place of the Sun, Apogee, and first *♈, January 1, *at Midnight,* 1804, *New Style?*

	☉ s	°	′	″	Ap. ☉ s	°	′	″	1*♈. s	°	′	″
N. S. 1800	9	9	53	55	3	9	25	57	1	0	23	28
Mo. Yrs 4		+	1	49		+	4	6		+	3	22
B. Jan. 1st 1804	9	9	55	44	3	9	30	3	1	0	26	50
Hours 12		+	29	34	. . . . . .				. . . . . .			
					9	10	25	18				
	9	10	25	18	6	0	55	15	☉ M. Anom.			

EXAMPLE III.

To find the Place of the Sun, Apogee and 1*♈, February 29, 19h 13m 52s, *P. M.* 1848, *New Style?*

	☉ s	°	′	″	Ap. ☉ s	°	′	″	1*♈. s	°	′	″
N.S. 1800	9	9	53	55	3	9	25	57	1	0	23	28
Mo. Ys 48		+	21	51		+	49	12		+	40	24
February	1	0	33	18				5				4
B. Days 28	0	27	35	53				5				4
Hours 19			46	49								
Mins 13				32	3	10	15	19	1	1	4	c
Secs 52				2	. . . . . .							
					11	9	12	20				
	11	9	12	20								
					7	28	57	1	☉ M. Anom.			

The same may be performed by reducing the Days of the Months in the above *Examples* to the Old Style.

NOTE, The *Gregorian* is reduced to the *Julian* Style, (serving equally for Computation) by subtracting the Number of Days Difference. And, the contrary, by adding the Days Difference, the *Julian* is reduced to the *Gregorian* Style. —— *To determine universally the Number of Days Difference betwixt* New *and* Old Style.

RULE.——From the Hundreds of CHRIST, take their *Fourth*, adding Two; And the Days will remain betwixt *Old Style* and *New*.

EXAMPLE.—In 27|40
2+¼=8—
Rem. 19 Days Difference.

EQUATION of the SUN's CENTER, or of his *Mean* PLACE or ANOMALY to the True.

Argument. SUN's Mean Anomaly.

⊙ An.	Sign 0	Diff.	Sig. 1	Diff.	Sig. 2	Diff.	Sig. 3	Diff.	Sig. 4	Diff.	Sig. 5	Diff.	⊙ An.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0		0 56 52		1 39 15		1 55 49		1 41 22		0 59 0		30
1	0 1 59	1 59	0 58 36	1 44	1 40 16	1 1	1 55 50	0 1	1 40 22	1 0	0 57 12	1 48	29
2	0 3 58	1 59	1 0 18	1 42	1 41 15	0 59	1 55 49	0 1	1 39 20	1 2	0 55 23	1 49	28
3	0 5 57	1 59	1 1 59	1 41	1 42 13	0 58	1 55 46	0 3	1 38 16	1 4	0 53 34	1 49	27
4	0 7 56	1 59	1 3 39	1 40	1 43 8	0 55	1 55 42	0 4	1 37 10	1 6	0 51 44	1 50	26
5	0 9 54	1 58	1 5 18	1 39	1 44 2	0 54	1 55 35	0 7	1 36 3	1 7	0 49 53	1 51	25
6	0 11 52	1 58	1 6 57	1 39	1 44 54	0 52	1 55 26	0 9	1 34 53	1 10	0 48 1	1 52	24
7	0 13 50	1 58	1 8 33	1 3[illegible]	1 45 44	0 50	1 55 15	0 11	1 33 41	1 12	0 46 8	1 53	23
8	0 15 48	1 58	1 10 9	1 36	1 46 33	0 49	1 55 1	0 14	1 32 28	1 13	0 44 14	1 54	22
9	0 17 45	1 57	1 11 43	1 34	1 47 19	0 46	1 54 45	0 16	1 31 13	1 15	0 42 19	1 55	21
10	0 19 42	1 57	1 13 16	1 33	1 48 3	0 44	1 54 29	0 16	1 29 57	1 16	0 40 23	1 56	20
11	0 21 39	1 57	1 14 48	1 32	1 48 45	0 42	1 54 9	0 20	1 28 38	1 19	0 38 27	1 56	19
12	0 23 36	1 57	1 16 19	1 31	1 49 25	0 40	1 53 47	0 22	1 27 19	1 19	0 36 31	1 56	18
13	0 25 32	1 56	1 17 47	1 28	1 50 4	0 39	1 53 23	0 24	1 25 57	1 22	0 34 33	1 58	17
14	0 27 28	1 56	1 19 16	1 29	1 50 41	0 37	1 52 57	0 26	1 24 34	1 23	0 32 34	1 59	16
15	0 29 23	1 55	1 20 42	1 26	1 51 15	0 34	1 52 29	0 28	1 23 9	1 25	0 30 35	1 59	15
16	0 31 17	1 54	1 22 7	1 25	1 51 48	0 33	1 51 58	0 31	1 21 42	1 27	0 28 36	1 59	14
17	0 33 11	1 54	1 23 30	1 23	1 52 19	0 31	1 51 26	0 32	1 20 14	1 28	0 26 36	2 0	13
18	0 35 5	1 54	1 24 52	1 22	1 52 47	0 28	1 50 52	0 34	1 18 45	1 29	0 24 35	2 1	12
19	0 36 58	1 53	1 26 13	1 21	1 53 14	0 27	1 50 16	0 36	1 17 13	1 32	0 22 34	2 1	11
20	0 38 51	1 53	1 27 33	1 20	1 53 38	0 24	1 49 38	0 38	1 15 41	1 32	0 20 32	2 2	10
21	0 40 43	1 52	1 28 50	1 17	1 54 1	0 23	1 48 56	0 42	1 14 7	1 34	0 18 29	2 3	9
22	0 42 34	1 51	1 30 6	1 16	1 54 21	0 20	1 48 13	0 43	1 12 31	1 36	0 16 26	2 3	8
23	0 44 24	1 51	1 31 20	1 14	1 54 39	0 18	1 47 29	0 44	1 10 55	1 36	0 14 23	2 3	7
24	0 46 13	1 49	1 32 33	1 12	1 54 55	0 16	1 46 43	0 46	1 9 16	1 39	0 12 20	2 3	6
25	0 48 2	1 49	1 33 44	1 11	1 55 9	0 14	1 45 55	0 48	1 7 37	1 39	0 10 17	2 3	5
26	0 49 50	1 48	1 34 54	1 10	1 55 21	0 12	1 45 4	0 51	1 5 56	1 41	0 8 14	2 3	4
27	0 51 37	1 47	1 36 2	1 8	1 55 31	0 10	1 44 11	0 53	1 4 14	1 42	0 6 11	2 3	3
28	0 53 23	1 46	1 37 8	1 6	1 55 39	0 8	1 43 16	0 55	1 2 31	1 44	0 4 8	2 3	2
29	0 55 8	1 45	1 38 13	1 5	1 55 45	0 6	1 42 20	0 56	1 0 46	1 45	0 2 4	2 4	1
30	0 56 52	1 44	1 39 15	1 2	1 55 49	0 4	1 41 22	0 58	0 59 0	1 46	0 0 0	2 4	0
⊙ An.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	⊙ An.
	Sig. 11.		Sig. 10		Sig. 9		Sig 8		Sig. 7		Sig. 6		

Construction. The present Eccentricity of the Earth's Orbit is 1685 to the Semi-Transverse or mean Dist. ⊖ à ⊙ 100000: Whence the Aphelion Dist. is 101685 to the Perihelion Dist. 98315—Now by this Rule. As *Aph. Dist.* : *Perihelion Dist.* :: *Tang.* ½ *mean Anom.* : *Tang. 4th Arch* (nearly ½ true Anom.) *which added to* ½ *mean Anom. the* Sum *will be the* correct *Eccentric Anom. from Aphelion.* Again, A $\sqrt{\textit{Aph. Dist.}}$: $\sqrt{\textit{Perib. Dist.}}$ :: *Tan.* ½ *cor. Eccen. An.* : *Tan.* ½ *true An.*

Example. *To find the Equation to mean Anom. 30°?*

	°	′	″		Log.
½ Eccen. An.	14	45	43 ½	.. Tan.	9.4207865
				Const. Log.	9.9926815 +
½ True An.	14	31	34	.. Tan.	9.4134680
½ Mean Anom.	15				
Rem. ½ Equat.	0	28	26, and 56′ 52″ Equation required.		

					Log.
Half or 15°				Tan.	9.4280525
				Const. Log.	9.9853630 +
4th.	14°	31′	27″	Tan.	9.4134155
+ ½ M. Anom. =	29	31	27	Cor. Eccen. An.	

A Decimal Table for proportioning the *Difference* of EQUATIONS, at Sight.

N. B. A Dot or Point after a Decimal shews the Decimal to be complete; otherwise the last Figure is understood to repeat continually.

Mins are multd by Mins in Mins, Mins by Secs in Secs, or Secs by Mins in Secs, and Secs by Secs in Thirds, &c.

″×″	‴	‴	‴	‴	‴	‴	‴	‴	‴	″×″	‴	‴	‴	‴	‴	‴	‴	‴	‴
′×″	″	″	″	″	″	″	″	″	″	′×″	″	″	″	″	″	″	″	″	″
′×′	′	′	′	′	′	′	′	′	′	′×′	′	′	′	′	′	′	′	′	′
″ ′	10	20	30	40	50	60	70	80	90	″ ′	10	20	30	40	50	60	70	80	90
1	,16	,33	,5	,66	,83	1,	1,16	1,33	1,5.	31	5,16	10,33	15,5.	20,66	25,83	31,	36,16	41,33	46,5.
2	,33	,66	1,	1,33	1,66	2,	2,33	2,66	3,	32	5,33	10,66	16,	21,33	26,66	32,	37,33	42,66	48,
3	,5.	1,	1,5.	2,	2,5.	3,	3,5.	4,	4,5.	33	5,5.	11,	16,5.	22,	27,5.	33,	38,5.	44,	49,5.
4	,66	1,33	2,	2,66	3,33	4,	4,66	5,33	6,	34	5,66	11,33	17,	22,66	28,33	34,	39,66	45,33	51,
5	,83	1,66	2,5	3,33	4,16	5,	5,83	6,66	7,5.	35	5,83	11,66	17,5.	23,33	29,16	35,	40,83	46,66	52,5.
	10	20	30	40	50	60	70	80	90		10	20	30	40	50	60	70	80	90
6	1,	2,	3,	4,	5,	6,	7,	8,	9,	36	6,	12,	18,	24,	30,	36,	42,	48,	54,
7	1,16	2,33	3,5.	4,66	5,83	7,	8,16	9,33	10,5.	37	6,16	12,33	18,5.	24,66	30,83	37,	43,16	49,33	55,5.
8	1,33	2,66	4,	5,33	6,66	8,	9,33	10,66	12,	38	6,33	12,66	19,	25,33	31,66	38,	44,33	50,66	57,
9	1,5.	3,	4,5.	6,	7,5.	9,	10,5	12,	13,5.	39	6,5.	13,	19,5.	26,	32,5.	39,	45,5.	52,	58,5.
10	1,66	3,33	5,	6,66	8,33	10,	11,66	13,33	15,	40	6,66	13,33	20,	26,66	33,33	40,	46,66	53,33	60,
	10	20	30	40	50	60	70	80	90		10	20	30	40	50	60	70	80	90
11	1,83	3,66	5,5.	1,33	9,16	11,	12,83	14,66	16,5.	41	6,83	13,66	20,5.	27,33	34,16	41,	47,83	54,66	61,5.
12	2,	4,	6,	8,	10,	12,	14,	16,	18,	42	7,	14,	21,	28,	35,	42,	49,	56,	63,
13	2,16	4,33	6,5.	8,66	10,83	13,	15,16	17,33	19,5.	43	7,16	14,33	21,5.	28,66	35,83	43,	50,16	57,33	64,5.
14	2,33	4,66	7,	9,33	11,66	14,	16,33	18,66	21,	44	7,33	14,66	22,	29,33	36,66	44,	51,33	58,66	66,
15	2,5.	5,	7,5.	10,	12,5.	15,	17,5.	20,	22,5.	45	7,5.	15,	22,5.	30,	37,5.	45,	52,5.	60,	67,5.
	10	20	30	40	50	60	70	80	90		10	20	30	40	50	60	70	80	90
16	2,66	5,33	8,	10,66	13,33	16,	18,66	21,33	24,	46	7,66	15,33	23,	30,66	38,33	46,	53,66	61,33	69,
17	2,83	5,66	8,5.	11,33	14,16	17,	19,83	22,66	25,5.	47	7,83	15,66	23,5.	31,33	39,16	47,	54,83	62,66	70,5.
18	3,	6,	9,	12,	15,	18,	21,	24,	27,	48	8,	16,	24,	32,	40,	48,	56,	64,	72,
19	3,16	6,33	9,5.	12,66	15,83	19,	22,16	25,33	28,5.	49	8,16	16,33	24,5.	32,66	40,83	49,	57,16	65,33	73,5.
20	3,33	6,66	10,	13,33	16,66	20,	23,33	26,66	30,	50	8,33	16,66	25,	33,33	41,66	50,	58,33	66,66	75,
	10	20	30	40	50	60	70	80	90		10	20	30	40	50	60	70	80	90
21	3,5	7,	10,5.	14,	17,5.	21,	24,5.	28,	31,5.	51	8,5.	17,	25,5.	34,	42,5.	51,	59,5.	68,	76,5.
22	3,66	7,33	11,	14,66	18,33	22,	25,66	29,33	33,	52	8,66	17,33	26,	34,66	43,33	52,	60,66	69,33	78,
23	3,83	7,66	11,5.	15,33	19,16	23,	26,83	30,66	34,5.	53	8,83	17,66	26,5.	35,33	44,16	53,	61,83	70,66	79,5.
24	4,	8,	12,	16,	20,	24,	28,	32,	36,	54	9,	18,	27,	36,	45,	54,	63,	72,	81,
25	4,16	8,33	12,5.	16,66	20,83	25,	29,16	33,33	37,5.	55	9,16	18,33	27,5.	36,66	45,83	55,	64,16	73,33	82,5.
	10	20	30	40	50	60	70	80	90		10	20	30	40	50	60	70	80	90
26	4,33	8,66	13,	17,33	21,66	26,	30,33	34,66	39,	56	9,33	18,66	28,	37,33	46,66	56,	65,33	74,66	84,
27	4,5.	9,	13,5.	18,	22,5.	27,	31,5.	36,	40,5.	57	9,5.	19,	28,5.	38,	47,5.	57,	66,5.	76,	85,5.
28	4,66	9,33	14,	18,66	23,33	28,	32,66	37,33	42,	58	9,66	19,33	29,	38,66	48,33	58,	67,66	77,33	87,
29	4,83	9,66	14,5.	19,33	24,16	29,	33,83	38,66	43,5.	59	9,83	19,66	29,5.	39,33	49,16	59,	68,83	78,66	88,5.
30	5,	10,	15,	20,	25,	30,	35,	40,	45,	60	10,	20,	30,	40,	50,	60,	70,	80,	90,

To proportion the Diff. of Equations. As 1° or 60′ Difference of Argument is to *Minutes* and *Seconds*, Dif. of Equation, so are the Mins and Secs Dif. of *Argument* above whole Degrees to the Mins and Secs proportional Dif. of Equation, to be added to, or subtracted from, the *first* Equation, for the Equation sought.—Hence, the Mins and Secs Dif. of Equatn are ×d by the Mins and Secs Dif. of Argument, and the *Product* divided by 60: which Multiplication and Division (by *Parts*) the above *Table* performs, at Sight.

Example I. *The Sun's Equation for* 1s 15° 39′ 57″ *Sun's Anomaly is required?*

☉ Anom. ☉ Equation
1s 15° | −1° 20′ 42′ First Equation.
1 16 | −1 22 7
1 : +1 25 = 85″ Dif. Equan :: 39′ 57″ : 56,″58, &c.
by 39 57 Dif. Argument.
+ 56 to the first Equation.
☉ Equation −1 21 38 sought.

By Table.
39′ × 80″ = 52″
5 = 3,25
55,25 = 55″ 15‴
57″ × 80″ = 76‴ = 1 16
5 = 4‴,75 = 4 45 iv.
Proportl Equation + 56 35 45 correct.

N. B. Under *Units*, 1,2,3,4,5,6,7,8, or 9, a-top, against any No. of Mins or Secs on the Side, take out a Decimal more than for *tens*; and for Tenths 2 more; for Hundredths 3 more, &c.

EXAMPLES *of proportioning the* DIFFERENCE *of* ÆQUATIONS.

EXAMPLE II. Sun's *Place at Noon, June 10, 1756,* ♊ 19°. 52′ 0″ *required his Right Ascension?*

☉ Pl.	R. A.
♊ 19°	78° 2′ 3″
♊ 20	79 7 4

As Dif. 1° : +1 5 1 = 65′. 1″. Dif. increasing :: 52′. (Argt. above Degt.) + 56′. 20″. 52‴. Propl. Æquan. $= \frac{52' \times 65'.\ 1''}{60'}$

By TABLE.

52′ × 60′ . . . 52′					
5 . . . 4,33					
56,33 . . 56′ 20″ 0‴					
1″ . . . ,86″ .			52		
	+ 56	20	52	Propl. Æquan.
	78°	2	3	0	First Æquation.
☉ R. A. required . 78	58	23	52		Æquan. fought.

DECIMALLY.

65′ 1′ = { 65′,016
52′ = { . . 52′,

130032
325080
6)338|0,832
56′ 20″ 50‴ Prop. Æqn.

SEXAGESIMALLY.

Divide each Prod. exceeding 60 by 6, (when a Fig. to the Right is cut off) taking the Sum of the Quotients.

1″ { 65′ × 1″ } Dif. Æq. } × d
52′ { 52′ × 0″ } Dif. Arg. } togeth.

52‴ 130
325
6)338|0″
56′ 20″ 52‴ Propl. Æquan. fought.

SEXAGESIMALS are thus turned into DECIMALS, and the contrary, without a TABLE.

Seconds *are mentally turned into* Decimals *of a Minute, by dividing them by 6, supposing* 0 *to be placed before the Remainder, continually.— The first Decimal, thence arising, will be* Tenths, *the second,* Hundredths, &c. *except when the Seconds to be turned into Decimals are under* 6 ; *then the first Decimal arising (first supposing* 0 *placed before the Seconds to be divided by* 6) *will be Hundredths, the next Thousandths, &c. where an* 0 *must stand in Tenth's Place.*

Minutes *are mentally turned into* Decimals *of a* Degree, *in the same Manner*; Thirds *into Decimals of a* Second, *&c. (See an* Example *to the Right). And dividing the* lowest *Denomination by* 6, *then that* Quotient, *and the* next *Denomination higher by* 6, *as far as Degrees, or Hours, the* Decimals *of Sexagesimals are thus found, generally.*

Decimals *(of Degrees, Hours, and of lower Order) are universally turned into Sexagesimals, by multiplying all the Decimals to the* Right *Hand by* 6, *and cutting off the Product of the first Decimal, with what is carried from the rest, for the next Denomination lower, continually.*—Two or three Decimals to the *Right* being thus multiplied by 6, will determine the *Value* of the next Sexagesimal, *mentally*, or *at Sight.*

☞ IN SEXAGESIMAL PROPORTION, *Minutes* × *Minutes* = *Seconds*; *Minutes* × *Seconds* = *Thirds*; *Seconds* × *Seconds* = *Fourths*; *Seconds* × *Thirds* = *Fifths.* *Hence*, a Figure to the Right of a *Sexagesimal* being cut off, and all the Figures to the Left divided by 6, will give the Value of that Product, in Sexagesimals, a Denomination higher—The *Remainder*, before the Figure cut off, to be placed before that Figure, for the Value of the *lower* Denomination.

EXAMPLE of turning SEXAGESIMALS into DECIMALS, and the *contrary.*

Divided by 6.	23‴	= 23‴
	34″,383 . . .	= 34″23
	29,′57305 . .	29′ 34 23
	40°,492884259 =	40° 29 34 23
Multiplied by 6.	29′,57305554	*N. B.* A *Dot* over any Figure denotes a continl Repetition from thence.
	34″,3833324	
	22‴999944	

EXAMPLE III. *To find the Proportional Æquation from* 39′ 40″ *Dif. Æquation, and* 53′ 35″ *Difference of Argument?*

By TABLE.

53′ × 30′ . . 26′,5
9 . . 7,95
34,45 . . 34′ 27″ 0‴ 0iv
40″ . 35,″33 &c. . . 35 20 0
39′ × 30″ . 19″,5
5 . . 3,25
22,75 . . . 22 45 0
35″ × 40″ . 23‴,33 . . 23 20
35 25 28 20 Propl Æqn.

DECIMALLY.

39′ 40″ = | 39′,66
53 35 = | 53,58
31728
19830
11898
19830
6)212|4,9828
35′ 24″ fere.

SEXAGESIMALLY.

40″ { Dif. Æqu. 39′ × 40″ } 39′ | 40″
53″ { Dif. Arg. 53′ × 35″ } 35″ | 35″

120	117 . .	195 .	200
200	195 . .	117 .	120
212|0‴	206|7″	136|5‴	140|0iv
35″ 20‴ . .	34′ 27″ . .	22″45‴.	23‴ 20iv

35 20‴
22 45
23 20iv
Sum 35 25 28 20, correctly.

By LOGISTICAL LOGARITHMS.

		L. L.
Dif. Argt.	53′ 35″	0491
Dif. Æqn.	39 40	1797
Prl. Æqn.	35 25	2288

N. B. These Logistical Logarithms proportion the easiest, but not always the quickest, as in a direct Manner, which is less disturbing to Attention, than the turning (backward and forward) over Leaves.

By *Aliquot* PARTS of a DEGREE [or 60′. | UNIVERSALLY and DIRECTLY.

Thus 39′ . 40″ of 53,′583 (35″)	60′	OR, 53′ 35″ of 39′,666 (40″)	60′	,6611 = 1′	$\frac{1}{60}$ of 1°
30′. ½. 60′ . 26,791	30	48′. ,8 × 1°. 31,732	48′	,01102 = 1″	$\frac{1}{60}$ of 1′
6. $\frac{1}{10}$. 60′ . 5,358	6	5. 5 × 1′. 3,305	5	Multy 1° and 1′ by as many *Tenths* as there are 6 Mins. & 6 Secs, adding for Mins & Secs. over.	
3. ½. 6′ . 2,679	3	30″. ,5 × 1′. ,330	30″		
40″. $\frac{1}{9}$. 6′. ,595	40″	5 . 5 × 1″. ,055	5		
39′. 40″ . 35′,423 25″38	fum	53′ 35″ . 35′,422 25″32	fum		

NOTE. *A Table of aliquot Parts, and aliquot Parts of those, will expedite the above Proportion.*
Universally. As 23′ 12″ to 39′ 19″ so 44′ 53″ to 76′ 3″ 47‴
Decimally. As 23, 2 to 39, 31 so 44, 88 to 76′,044 = 76′ 3″ *fere*, at Sight.

Otherwise by the TABLE.

39′ 40″ | 53′,58
39′ × 50′ . 32′,5
3 . . 1,95
,5 . . ,325
,08 . . ,052
34,827 . . 34′ 49″ 37‴
40″ × 50′ . . 33″,33
3 . . 2
35,33 . . 35 19
Propl. Æqn. 35 24 56

The

The SUN's *proportional* DISTANCES from the EARTH to the Sun's Mean Diſtance from thence, 100000.—
The Eccentricity of the Earth's Orbit 1685 of ſuch Parts.

Argument. SUN's Mean Anomaly.

⊙M. An.	Sig. 0 ⊙ à ⊖	Dif.	Sig. 1 ⊙ à ⊖	Dif.	Sig. 2 ⊙ à ⊖	Dif.	Sig. 3 ⊙ à ⊖	Dif.	Sig. 4 ⊙ à ⊖	Dif.	Sig. 5 ⊙ à ⊖	Dif.	⊙M. An.
°													°
0	101685	0	101466	14	100864	25	100028	30	99180	26	98550	15	30
1	101685	1	101452	15	100839	25	99998	30	99154	25	98535	15	29
2	101684	1	101437	15	100814	26	99968	29	99129	25	98520	14	28
3	101683	2	101422	16	100788	26	99939	29	99104	25	98506	14	27
4	101681	2	101406	17	100762	26	99910	29	99079	25	98492	14	26
5	101679	3	101389	17	100736	27	99881	29	99054	25	98479	13	25
6	101676	3	101372	17	100709	27	99852	29	99029	25	98466	12	24
7	101673	4	101355	17	100682	27	99823	29	99004	24	98454	12	23
8	101669	4	101338	18	100655	27	99794	29	98980	24	98442	11	22
9	101665	5	101320	18	100628	27	99765	29	98956	23	98431	10	21
10	101660	5	101302	18	100601	27	99736	29	98933	22	98421	10	20
11	101655	6	101284	19	100574	27	99707	29	98911	22	98411	10	19
12	101649	6	101265	19	100547	28	99678	29	98889	22	98401	9	18
13	101643	7	101246	20	100519	28	99649	29	98867	22	98392	9	17
14	101636	7	101226	20	100491	28	99620	29	98845	21	98383	8	16
15	101629	7	101206	20	100463	28	99591	29	98824	21	98375	8	15
16	101622	8	101186	21	100435	28	99562	28	98803	21	98367	7	14
17	101614	8	101165	21	100407	28	99534	28	98782	20	98360	7	13
18	101606	9	101144	22	100379	29	99506	28	98762	20	98353	6	12
19	101597	10	101122	22	100350	29	99478	28	98742	20	98347	5	11
20	101587	10	101100	23	100321	29	99450	28	98722	19	98342	5	10
21	101577	11	101077	23	100292	29	99422	28	98703	19	98337	4	9
22	101566	11	101054	23	100263	29	99394	28	98684	18	98333	4	8
23	101555	12	101031	23	100234	29	99366	27	98666	18	98329	4	7
24	101543	12	101008	23	100205	29	99339	27	98648	17	98325	3	6
25	101531	12	100985	23	100176	29	99312	27	98631	17	98322	3	5
26	101519	13	100962	24	100147	29	99285	26	98614	17	98319	2	4
27	101506	13	100938	24	100118	30	99259	27	98597	16	98317	1	3
28	101493	13	100914	25	100088	30	99232	26	98581	16	98316	1	2
29	101480	14	100889	25	100058	30	99206	26	98565	15	98315	0	1
30	101466		100864		100028		99180		98550		98315		0
°													°
⊙M. An.	⊙ à ⊖ Sig. 11	Dif.	⊙ à ⊖ Sig. 10	Dif.	⊙ à ⊖ Sig. 9	Dif.	⊙ à ⊖ Sig. 8	Dif.	⊙ à ⊖ Sig. 7	Dif.	⊙ à ⊖ Sig. 6	Dif.	⊙M. An.

CONSTRUCTION. As Sine ½ true Anom. : Sine ½ excent. An. :: √Perihelion Diſt. : √Diſt. fr. Sun; the Square of which is the Diſtance, or the doubled Logarithm, the Log. of the Diſtance from the Sun required.

EXAMPLE. *To determine the Sun's proportional Diſtance from the Earth for 30° M. Anom.?*

	° ′ ″		Com. Logˢ.
½ True Anom.	14 31 33,3	.. Sine	0,6006415 Co.
½ Ecccen. Anom.	14 45 43 ½	.. Sine	9,4062095
√Perih. Diſt.	98315 :	. . . .	2,4963099
			2,5031609
Proportional Diſtance from the Sun	101466	. .	5,0063218 Doubled.

N. B. *In this Proportion the true and excentric Anomalies muſt be taken to Tenths of a Second, or to Thirds,* for the proportional Diſtance from the Sun to come out correct: The above Table being a Work of great Labour.

LOGARITHMS

LOGARITHMS of the foregoing proportional Distances of the SUN from the EARTH, to the Mean Distance 100000; and the Eccentricity of the Earth's Orbit 1685.

Argument. SUN's Mean ANOMALY.

⊙ M. An °	Sig. 0 Logar.	Dif.	Sig. 1 Logar.	Dif.	Sig. 2 Logar.	Dif.	Sig. 3 Logar.	Dif.	Sig. 4 Logar.	Dif.	Sig. 5 Logar.	Dif.	⊙ M. An °
0	5,0072568		5,0063205		5,0037362		5,0001216		4,9964241		4,9936566		30
1	5,0072568	0	5,0062606	599	5,0036285	1077	4,9999913	1303	4,9963102	1139	4,9935905	661	29
2	5,0072526	42	5,0061964	642	5,0035208	1077	4,9998610	1303	4,9962007	1195	4,9935244	661	28
3	5,0072483	43	5,0061322	644	5,0034088	1120	4,9997350	1260	4,9960912	1195	4,9934627	617	27
4	5,0072398	85	5,0060636	686	5,0032968	1120	4,9996090	1260	4,9959816	1096	4,9934010	617	26
5	5,0072312	86	5,0059908	728	5,0031847	1121	4,9994829	1261	4,9958720	1096	4,9933436	574	25
6	5,0072184	118	5,0059180	728	5,0030683	1164	4,9993568	1261	4,9957624	1096	4,9932863	573	24
7	5,0072056	128	5,0058452	728	5,0029518	1165	4,9992306	1262	4,9956527	1097	4,9932334	529	23
8	5,0071885	171	5,0057723	729	5,0028353	1165	4,9991044	1262	4,9955474	1053	4,9931804	530	22
9	5,0071714	171	5,0056952	771	5,0027188	1165	4,9989782	1262	4,9954421	1053	4,9931319	485	21
10	5,0071501	213	5,0056180	772	5,0026023	1165	4,9988519	1263	4,9953412	1009	4,9930878	441	20
11	5,0071287	214	5,0055408	772	5,0024857	1166	4,9987256	1263	4,9952446	966	4,9930436	442	19
12	5,0071031	256	5,0054594	814	5,0023691	1166	4,9985993	1263	4,9951480	966	4,9929995	441	18
13	5,0070775	256	5,0053779	815	5,0022482	1209	4,9984729	1264	4,9950514	966	4,9929598	397	17
14	5,0070475	300	5,0052921	858	5,0021272	1210	4,9983465	1264	4,9949547	967	4,9929201	397	16
15	5,0070176	299	5,0052063	858	5,0020061	1211	4,9982201	1264	4,9948624	923	4,9928847	354	15
16	5,0069877	299	5,0051204	859	5,0018851	1210	4,9980936	1265	4,9947701	923	4,9928494	353	14
17	5,0069536	341	5,0050301	903	5,0017640	1211	4,9979715	1221	4,9946778	923	4,9928185	309	13
18	5,0069193	343	5,0049401	900	5,0016428	1212	4,9978483	1222	4,9945899	879	4,9927876	309	12
19	5,0068809	384	5,0048456	945	5,0015174	1254	4,9977270	1223	4,9945019	880	4,9927611	265	11
20	5,0068381	428	5,0047512	944	5,0013918	1256	4,9976048	1222	4,9944139	880	4,9927390	221	10
21	5,0067954	427	5,0046523	989	5,0012663	1255	4,9974825	1223	4,9943304	835	4,9927170	220	9
22	5,0067483	471	5,0045535	988	5,0011407	1256	4,9973602	1223	4,9942467	837	4,9926993	177	8
23	5,0067013	470	5,0044546	989	5,0010151	1256	4,9972378	1224	4,9941675	792	4,9926816	177	7
24	5,0066500	513	5,0043557	989	5,0008894	1257	4,9971198	1180	4,9940883	792	4,9926640	176	6
25	5,0065986	514	5,0042568	989	5,0007637	1257	4,9970017	1181	4,9940134	749	4,9926507	133	5
26	5,0065473	513	5,0041579	989	5,0006379	1258	4,9968836	1181	4,9939386	748	4,9926375	132	4
27	5,0064917	556	5,0040547	1032	5,0005122	1257	4,9967699	1137	4,9938637	749	4,9926286	89	3
28	5,0064361	556	5,0039514	1033	5,0003820	1302	4,9966517	1182	4,9937932	705	4,9926242	44	2
29	5,0063804	557	5,0038438	1076	5,0002518	1302	4,9965379	1138	4,9937227	705	4,9926198	44	1
30	5,0063205	599	5,0037362	1076	5,0001216	1302	4,9964241	1138	4,9936566	661	4,9926198	0	0
° ⊙ M. An	Logar. Sig. 11	Dif.	Logar. Sig. 10	Dif.	Logar. Sig. 9	Dif.	Logar. Sig. 8	Dif.	Logar. Sig. 7	Dif.	Logar. Sig. 6	Dif.	° ⊙ M. An

EXAMPLE. *To find the Logarithm of the Sun's Distance answering to the* Sun's Mean Anomaly 4ˢ 26° 19′ 37″?

Logarithm
Anomaly 4ˢ 26° . . . 4,9939386
For 19′ 37″ . . — 245

Log. ⊙ à ⊖ 4,9939141 required.

By PARTS.

60′ or 1° . . . 749 | 12,5=1′
18′ . . ,3×1° 224,7 | ,208=1″
1′ 12,5
36″.,6×1′ . . 7,5
2″ . . . . ,2
19′37″ . . — 244,9 | Answer.

By DECIMALS.

19′,61 = 19′ 37″ Dif. Argumᵗ.
Difference 749 decreasing

17649
7844
13727

6)1468|7,89
— 245 *fere.*

By LOGISTICAL LOGARITHMS.

	L. L.
749 = 12′ 29″	0,6818
19 37	0,4855
—245 = 4 5	1,1673

Mean

EQUATION of the SUN's *true* ANOMALY, or PLACE, to the MEAN.

Argument. SUN's true ANOMALY.

⊙ true An.	Sig. 0 +	Dif.	Sig. 1 +	Dif.	Sig. 2 +	Dif.	Sig. 3 +	Dif.	Sig. 4 +	Dif.	Sig. 5 +	Dif.	⊙ true An.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	2 3	0 58 34	1 45	1 40 58	0 58	1 55 51	0 2	1 39 42	1 3	0 57 17	1 46	30
1	0 2 3	2 3	1 0 19	1 44	1 41 56	0 58	1 55 49	0 6	1 38 39	1 3	0 55 31	1 46	29
2	0 4 6	2 3	1 2 3	1 42	1 42 54	0 54	1 55 43	0 6	1 37 36	1 6	0 53 45	1 46	28
3	0 6 9	2 3	1 3 45	1 42	1 43 48	0 54	1 55 37	0 9	1 36 30	1 7	0 51 59	1 48	27
4	0 8 12	2 2	1 5 27	1 42	1 44 42	0 51	1 55 28	0 11	1 35 23	1 10	0 50 11	1 48	26
5	0 10 14	2 2	1 7 9	1 38	1 45 33	0 50	1 55 17	0 12	1 34 13	1 12	0 48 23	1 50	25
6	0 12 16	2 2	1 8 47	1 39	1 46 23	0 49	1 55 5	0 17	1 33 1	1 12	0 46 33	1 50	24
7	0 14 18	2 2	1 10 26	1 36	1 47 12	0 44	1 54 48	0 18	1 31 49	1 14	0 44 43	1 51	23
8	0 16 20	2 1	1 12 2	1 35	1 47 56	0 43	1 54 30	0 16	1 30 35	1 16	0 42 52	1 52	22
9	0 18 21	2 1	1 13 37	1 34	1 48 39	0 41	1 54 14	0 23	1 29 19	1 18	0 41 0	1 53	21
10	0 20 22	2 1	1 15 11	1 33	1 49 20	0 38	1 53 51	0 24	1 28 1	1 18	0 39 7	1 52	20
11	0 22 23	2 1	1 16 44	1 30	1 49 58	0 39	1 53 27	0 25	1 26 43	1 21	0 37 15	1 54	19
12	0 24 24	1 59	1 18 14	1 31	1 50 37	0 36	1 53 2	0 28	1 25 22	1 21	0 35 21	1 54	18
13	0 26 23	1 59	1 19 45	1 28	1 51 13	0 31	1 52 34	0 29	1 24 1	1 24	0 33 27	1 55	17
14	0 28 22	1 59	1 21 13	1 27	1 51 44	0 33	1 52 5	0 34	1 22 37	1 26	0 31 32	1 56	16
15	0 30 21	1 58	1 22 40	1 24	1 52 17	0 29	1 51 31	0 32	1 21 11	1 26	0 29 36	1 55	15
16	0 32 19	1 57	1 24 4	1 23	1 52 46	0 26	1 50 59	0 35	1 19 45	1 27	0 27 41	1 57	14
17	0 34 16	1 57	1 25 27	1 22	1 53 12	0 26	1 50 24	0 38	1 18 18	1 31	0 25 44	1 57	13
18	0 36 13	1 57	1 26 49	1 22	1 53 38	0 22	1 49 46	0 39	1 16 47	1 30	0 23 47	1 57	12
19	0 38 10	1 56	1 28 11	1 17	1 54 0	0 22	1 49 7	0 45	1 15 17	1 32	0 21 50	2 0	11
20	0 40 6	1 55	1 29 28	1 17	1 54 22	0 17	1 48 22	0 43	1 13 45	1 34	0 19 50	1 58	10
21	0 42 1	1 54	1 30 45	1 15	1 54 39	0 16	1 47 39	0 44	1 12 11	1 33	0 17 52	1 59	9
22	0 43 55	1 52	1 32 0	1 12	1 54 55	0 15	1 46 55	0 47	1 10 38	1 37	0 15 53	1 59	8
23	0 45 47	1 53	1 33 12	1 13	1 55 10	0 12	1 46 8	0 49	1 9 1	1 36	0 13 54	1 58	7
24	0 47 40	1 51	1 34 25	1 11	1 55 22	0 10	1 45 19	0 53	1 7 25	1 39	0 11 56	1 59	6
25	0 49 31	1 51	1 35 36	1 8	1 55 32	0 8	1 44 26	0 53	1 5 46	1 39	0 9 57	1 59	5
26	0 51 22	1 49	1 36 44	1 6	1 55 40	0 6	1 43 33	0 56	1 4 7	1 41	0 7 58	1 59	4
27	0 53 11	1 49	1 37 50	1 5	1 55 46	0 4	1 42 37	0 56	1 2 26	1 41	0 5 59	1 59	3
28	0 55 0	1 47	1 38 55	1 1	1 55 50	0 1	1 41 41	0 58	1 0 45	1 43	0 4 0	2 0	2
29	0 56 47	1 47	1 39 56	1 2	1 55 51	0 0	1 40 43	1 1	0 59 2	1 45	0 2 0	2 0	1
30	0 58 34		1 40 58		1 55 51		1 39 42		0 57 17		0 0 0		0
⊙ true An.	— Sig. 11	Dif.	— Sig. 10	Dif.	— Sig. 9	Dif.	— Sig. 8	Dif.	— Sig. 7	Dif.	— Sig. 6	Dif.	⊙ true An.

CONSTRUCTION. From the Equation of the Sun's Center.—As the Compt. to 60′ of the Dif. of any Equation, and the next Equation following, as far as the *greatest*, but Dif. +60′ beyond the *Greatest*, *is to* that Dif. *so is* the former Equation of the two, to the *Proportional* Quantity to be added to, or subtracted from, that former Equation (according as it *increases* or *decreases*) for the *correct Equation* (of the true to the M.An. corresp^t.) to the Number of Deg. of the true, equal to the Deg. of M. An. of the Sun's Center; but with a *contrary* Sign. This Proportion arises from hence. *As any Incr. of true An. : to corresp. Incr. or Decr. of Equation of the true to M. An. :: any other Incr. of true An. (but of the first Eq. or Compl. to whole Degrees of true An.) to what must be added to or subtracted from the first Eq. for the absolute Eq. of the increased true An. to M. Anom. correspondent.*

EXAMPLE I. *To find the Equation of true to M. Anom. for* 1ˢ 12° *true An.* Sun?

M.An.	Sun tr. An.	Eq. Sun Center				Log. Logar^s.
1ˢ 12°	1ˢ 10° 43′ 41″	+1° 16′ 19″ = 1ˢ 12°	Sun's M. An.		′ ″	
1 13	1 11 42 13	+1 17 47 = 1 13		As	−58 32	9.9893 co.
As Dif. Incr.	58 32 (60′—D.Eq.) : 1 28 D. Eq.	:: 1° 16′ 19″ : 1′ 55″		To	+ 1 28	1.6118
		+1 55		So	−76 19	9.8956 co.
		+ 1 18 14 Eq. req^d.		To	+ 1 55	1.4967

Sun's tr. An. 1ˢ 12° . . . . Whence M. Anom. . . . . 1ˢ 13° 18′ 14″ required.

EXAMPLES of the CONSTRUCTION and USE of the foregoing TABLE.

EXAMPLE II. *To find the Equation for 4ˢ 19° true Anomaly?*

M. An.	⊙ true An.	Eq. ⊙ Center		
4ˢ 19°	4ˢ 17 42′ 47″	+ 1° 17′ 13″	= 4ˢ 19°	Sun's M. An.
4 20	4 18 44 19	+ 1 15 41	= 4 20	

As Dif. Incr. 1 1 32 (D. Eq. + 60′) : 1 32 Dif. Eq. decrˢ :: 1° 17′ 13″ : 1′ 56″
— 1 56 decr.
+ 1 15 17 Eq. reqᵈ.

	′ ″	
As	+ 61 32	0.0109
To	+ 1 32	1.5925
So	— 77 13	9.8905 co.
To	+ 1 56	1.4939

N. B. The foregoing Table is used with the same Facility as that of the Sun's Center.

Sun's tr. An. 4ˢ 19°
4 20 15 17 M. Anom. reqᵈ. to which answers (fr. Eq. ⊙ Center) — 1° 15′ 17″ Eq.

N. B. The *foregoing* Construction finds the Equation of the true from the mean Anomaly correctly enough, from the *Equation of the Sun's Center,* when those Equations and their Differences are correct. But near the *greatest Equation,* when the *Differences* are very small, an Error of ½″, or ¼″, among those *Equations* or *Differences,* will create an Error of 2″, or more, in proportioning. Wherefore the following *Construction* takes PLACE of, or exceeds the former for Correction.

To determine UNIVERSALLY *and* CORRECTLY, *the* Mean *from the* True *Anomaly given, in all Orbits whatsoever?*

RULE.—As √Perih. Dist. : √Aph. Dist. : : Tan. ½ true Anom. : Tan. ½ correct Excentric Anom. which doubled is the Ex. Anom. Now, by the Nature of a PLANET's or COMET's Motion in an elliptical Orbit, and the Principles of Trigonometry. As Sem. Transf. (= Rad.) : S. Excentr. An : : Excentricity : Length Arch L, whose Degrees D, are the Diff. of the Degrees of the *Mean* above those of the *Excentr.* Anomaly. Therefore Rad. : 59°,295779 : : L : D, Degrees, to be added to the Excentric for the *mean Anom. required.*

In the Earth's Orbit, the Eccentricity is 1685 of such Parts as the Sem. Transverse or mean Dist. ⊖ à ⊙ = 100000, the Perih. Dist. = 98315 and Aph. Dist. 101685, and let it be required to determine the Mean from the true Anomalies, and consequently the *Equations,* of 86°, 87°, 88°, 89°, 90°, 91°, 92°, 93°, 94°, and 95°. Hence, from the above Proportions,

Tr. An.	+ Equations.	Dif.	Tr. An.	+ Equations.	Dif.	
2ˢ 26°	1° 55′ 40″	0′ 6″	3ˢ 1°	1° 55′ 49″	0′ 6″	*Agreeing*
2 27	1 55 46	0 4	3 2	1 55 43	0 6	*with the*
2 28	1 55 50	0 1	3 3	1 55 37	0 9	*Table.*
2 29	1 55 51	0 0	3 4	1 55 28	0 11	p. 17.
3 0	1 55 51		3 5	1 55 17		

To *Conf. Log.* 0.0073185 add the Log. Tan. ½ Degrees true Anom. For Log. Tan. ½ Degrees of Excentric Anomaly. And To *Conf. Log.* 9.9847226 add Log. S. Excentric An. (rej. Rad.) For Log. of a Number of Degrees to be *added* to the Degrees of Excentric Anom. for the Degrees of Mean Anomaly required. Whence the *Equations* as on the *Left.*

EXAMPLE.	Conf. Log.	EXAMPLE.	Conf. Log.
	0.0073185		9.9847226
½ tr. An. 44°. T.	9.9848372	88° 57′ 54″,62, S.	9.9999292
½ Ex 44°.28′.57″,31 T	9.9921557	D. 57 55 + . . L.	9.0846518
88. 57. 54,62	*Cor. ex. An.*	89° 55′ 49″,62	M. An. req.

By *Ward's* Hypoth. As Perih. Dist. : Aph. Dist. : : Tan. ½ tr. An. : T. ½ m. An. nearly.

By *Bullialdus's* Correction of the M. Anom. tho', but a near Correction. } As Sem. Conj. : Sem. Transf. : : Tan. M. An. : Tan. corrected M. Anomaly.

Hence, const. Log. 0.0146370 + L. Tan. ½ tr. An. = L. Tan. ½ m. Anom. to be corrected. And const. L. 0.0000617 + L. Tan. of that m. Anom. = Log. T. corrected An. for the Earth's *Orbit.*

To find the Time of the SUN's *Entrance into 10° ♈ in the Year 1758?*

By our *Tables.*	Apogee ⊙. s ° ′ ″	
N.S. Year 1758	3 8 42 54	
By *Palla.* 1756, Mar. 30	+ 15	
At the req. time: M. Place Ap. ⊙	3 8 43 9	—
True Place ⊙	0 10 0 0	from
True Anom. ⊙	9 1 16 51	rem.
Correspontᵗ. Eqⁿ.	* — 1 55 50	—
M. Place then ⊙	0 8 4 10	from
M. Pl. ⊙ N. S. 1758	9 10 4 12	—
	2 27 59 58	rem.
Mean Time requᵈ.: March 30	2 27 43 21	—
	16 37	rem.
Hours 6	. . . 14 47	—
	1 50	rem.
Minutes 44	. . . 1 48	25‴ —
	1	35 rem
Seconds 39	*fere* . . . 1	36

To find the Time of the SUN's *Entrance into ♌ 22° 22′, in 1761?*

By our *Tables.*	Apogee ⊙. s ° ′ ″	
N. S. Year 1761	3 8 45 58	
By *Pal* 1756, *Aug.* 14	+ 31	
At the req. time: M. Pl. Ap. ⊙	3 8 46 29	—
True Place ⊙	4 22 22 0	From
True Anom. ⊙	1 13 35 31	rem.
Correspᵗ. Equⁿ	* + 1 20 37	+
M. Place ⊙	4 23 42 37	From
M. Pl. ⊙ N. S. 1761	9 10 20 21	—
	7 13 22 16	rem.
Mean Time requᵈ.: Aug. 14	7 12 45 22	—
	36 54	rem.
Hours 14	. . . 34 30	—
	2 24	rem.
Minutes 58	. . . 2 22	55‴ —
	1	5 rem.
Seconds 26	*fere* . . . 1	4

To find the SUN's *true Places to the foregoing Times?*

	M. Pl. ⊙ s ° ′ ″	Apogee ⊙ s ° ′ ″
N.S. Yʳ 1758	9 10 4 12	3 8 42 54
March 30	2 27 43 21	15
Hours 6	. . . 14 47	3 8 43 9
Minutes 44	. . . 1 48	
Seconds 39	 2	0 8 4 10
M. Pl. ⊙	0 8 4 10	8 29 21 1
Equation	+ 1 55 50	M. An. ⊙
True Pl. ⊙	0 10 0 0	required.
N.S. Yʳ 1761	9 10 20 21	3 8 45 58
Aug. 14	7 12 45 22	+ 31
Hours 14	. . . 34 30	3 8 46 29
Minutes 58	. . . 2 23	
Seconds 26	 1	4 23 42 37
M. Pl. ⊙	4 23 42 37	1 14 56 8
Equation	— 1 20 37	M. An. Sun
True Pl. ⊙	4 22 22 0	required.

RULE. Observe the Day on which the Sun entered that Sign by some Ephemeris on the Leap-Year preceding the Time required. Then from the Sun's true Place, for the Time required, take Sun's *Apogee,* and the Sun's true An. will remain; from whence get the Equation of true to mean An. which add to or subtract from the Sun's true Pl. *(according as the Sign directs)* and you will have ⊙ M. Pl. for the Time required.—From which Pl. deduct M. Pl. ⊙ for the **Year,** and out of what remains deduct the Mot. for the **Month-Day,** and from that Remainder the Mot. for Hours, &c. till nothing remains, and you will have the M. Time of the Sun's Entrance into *any Point of the Ecliptic required.*

The tr. An. every true Year, *decreasing* by the *Increase* of the Sun's Apog. in that Time, It is evident, from above *, that the Sun returns to the *same Point of the Ecliptic,* each true Year, *later* than on the former Year by the Incr. or Decr. of Eqⁿ, of the Sun's true to his M. Pl. or Anom. turned into *Time,* and added to or subtracted from 5ʰ 48ᵐ 54ˢ 46ᵗʰ the *Surplus* of our mean Solar Yʳ above 365 Dˢ, in which a M. Revolution is completed.

N.B.	Eqⁿ	The Time.	
Increase	—	—	+ 365ᵈ 5ʰ 48ᵐ 54ˢ 46ᵗʰ, &c. = *Tr. Solar Yʳ.*
Decrease	—	+	
Increase	+	+	
Decrease	+	—	

Hence, the M. An. ⊙ decreases in the true Year or ⊙'s Return to the *same Point* of the **Ecliptic,** by *Sum* of the **Increase** of the Sun's *Apog.* and Dif. of Eqⁿ (of the true to M. Anom.) in the *same Time;* by which *Decr.* of the Sun's **M. An.** in each true **Year,** the Equation to the *absolute Equation of Time,* following, is determined.

ABSOLUTE EQUATION of TIME, for the SUN'S APOGEE in ♋ 9°, about 1774. With the *Subordinate Equation of Time*, to which Equation, for 58 Years, or 1 Degree *Increase* or *Decrease* of the Sun's Apogee, from that of ♋ 9°.

Argument. SUN'S true PLACE in the *Ecliptic*.

⊙ tr. Pl.	♈ 0 A. M. + −	Diff.	♉ 1 A. M. − +	Diff.	♊ 2 A. M. − +	Diff.	♋ 3 A. M. + −	Diff.	♌ 4 A. M. + −	Diff.	♍ 5 A. M. + −	Diff.
°	m s	s.	m s	s	m s	s	m s	s	m s	s	m s	s
0	7 37		1 9		3 50		1 14		5 58		2 21	
1	7 18	19	1 22	13	3 47	3	1 28	14	6 0	2	2 5	16
2	6 59	19	1 35	13	3 42	5	1 41	13	6 1	1	1 48	17
3	6 40	19	1 47	12	3 37	5	1 54	13	6 3	2	1 31	17
4	6 21	19	1 59	12	3 32	5	2 7	13	6 2	1	1 14	17
5	6 3	18	2 10	11	3 26	6	2 20	13	6 2	0	0 57	17
6	5 44	19	2 22	12	3 19	7	2 33	13	6 0	2	0 38	19
7	5 25	19	2 32	10	3 12	7	2 46	13	5 57	3	0 20	18
8	5 6	19	2 42	10	3 4	8	2 59	13	5 55	2	0 1	19
9	4 47	19	2 52	10	2 56	8	3 11	12	5 52	3	− + 0 18	19
10	4 28	19	3 1	9	2 48	8	3 24	13	5 48	4	0 38	20
11	4 9	19	3 9	8	2 38	10	3 36	12	5 43	5	0 58	20
12	3 51	18	3 16	7	2 28	10	3 47	11	5 38	5	1 18	20
13	3 32	19	3 23	7	2 18	10	3 58	11	5 33	5	1 38	20
14	3 14	18	3 30	7	2 7	11	4 9	11	5 26	7	1 59	21
15	2 55	19	3 35	5	1 57	10	4 20	11	5 18	8	2 19	20
16	2 37	18	3 41	6	1 47	10	4 29	9	5 10	8	2 40	21
17	2 19	18	3 46	5	1 35	12	4 39	10	5 2	8	3 1	21
18	2 1	18	3 50	4	1 23	12	4 48	9	4 53	9	3 22	21
19	1 43	18	3 35	3	1 11	12	4 56	8	4 44	9	3 43	21
20	1 27	16	3 56	3	0 59	12	5 5	9	4 34	10	4 4	21
21	1 10	17	3 58	2	0 46	13	5 13	8	4 23	11	4 26	22
22	0 53	17	4 0	2	0 34	12	5 19	6	4 11	12	4 48	22
23	0 36	17	4 0	0	0 21	13	5 26	7	3 59	12	5 9	21
24	0 20	16	4 1	1	0 8	13	5 32	6	3 47	12	5 31	22
25	0 4	16	4 0	0	+ − 0 6	14	5 39	7	3 33	14	5 52	21
26	− + 0 11	15	4 0	0	0 20	14	5 44	5	3 20	13	6 14	22
27	0 25	14	4 0	0	0 33	13	5 49	5	3 5	15	6 36	22
28	0 40	15	3 57	3	0 47	14	5 53	4	2 51	14	6 56	20
29	0 54	14	3 54	3	1 0	13	5 55	2	2 36	15	7 17	21
30	1 9	14	3 50	4	1 14	14	5 58	3	2 21	15	7 39	22

⊙ tr. Pl.	♎ 6 A. M. − +	Diff.	♏ 7 A. M. − +	Diff.	♐ 8 A. M. − +	Diff.	♑ 9 A. M. − +	Diff.	♒ 10 A. M. + −	Diff.	♓ 11 A. M. + −	Diff.	⊙ tr. Pl.
°	m s	s	m s	s	m s	s	m s	s	m s	s	m s	s	°
0	7 39		15 34		13 34		1 11		11 29		14 20		0
1	8 0	21	15 41	7	13 18	16	0 42	29	11 47	18	14 14	6	1
2	8 21	21	15 48	7	13 1	17	0 13	29	12 4	17	14 7	7	2
3	8 41	20	15 54	6	12 43	18	+ − 0 17	30	12 20	16	14 0	7	3
4	9 1	20	15 59	5	12 24	19	0 46	29	12 33	13	13 53	7	4
5	9 21	20	16 4	5	12 4	20	1 15	29	12 48	15	13 45	8	5
6	9 41	20	16 8	4	11 43	21	1 44	29	13 0	12	13 35	10	6
7	10 1	20	16 10	2	11 22	21	2 13	29	13 13	13	13 26	9	7
8	10 20	19	16 12	2	11 1	21	2 43	30	13 25	12	13 15	11	8
9	10 39	19	16 13	1	10 39	22	3 11	28	13 35	10	13 4	11	9
10	10 58	19	16 14	1	10 16	23	3 40	29	13 45	10	12 52	12	10
11	11 16	18	16 14	0	9 53	23	4 9	29	13 54	9	12 39	13	11
12	11 34	18	16 13	1	9 29	24	4 36	27	14 3	9	12 27	12	12
13	11 52	18	16 12	1	9 5	24	5 3	27	14 11	8	12 14	13	13
14	12 9	17	16 9	3	8 39	26	5 30	27	14 17	6	12 1	13	14
15	12 26	17	16 5	4	8 14	25	5 56	26	14 22	5	11 47	14	15
16	12 42	16	16 1	4	7 48	26	6 22	26	14 28	6	11 33	14	16
17	12 58	16	15 56	5	7 22	26	6 48	26	14 32	4	11 18	15	17
18	13 14	16	15 50	6	6 55	27	7 13	25	14 35	3	11 3	15	18
19	13 29	15	15 43	7	6 28	27	7 37	24	14 38	3	10 48	15	19
20	13 43	14	15 36	7	6 0	28	8 2	25	14 40	2	10 32	16	20
21	13 57	14	15 28	8	5 32	28	8 25	23	14 42	2	10 16	16	21
22	14 10	13	15 18	10	5 4	28	7 49	24	14 43	1	9 58	18	22
23	14 23	13	15 7	11	4 36	28	9 11	22	14 43	0	9 41	17	23
24	14 35	12	14 55	12	4 7	29	9 32	21	14 42	1	9 24	17	24
25	14 46	11	14 44	11	3 38	29	9 54	22	14 40	2	9 7	17	25
26	14 57	11	14 32	12	3 8	30	10 14	20	14 37	3	8 49	18	26
27	15 7	10	14 19	13	2 39	29	10 35	21	14 34	3	8 31	18	27
28	15 17	10	14 5	14	2 10	29	10 53	20	14 30	4	8 13	18	28
29	15 26	9	13 50	15	1 41	29	11 12	19	14 26	4	7 55	18	29
30	15 34	8	13 34	16	1 11	30	11 29	17	14 20	6	7 37	18	30

⊙ tr. Pl.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	Equa^n. 1° Sun Ap. Inc. dec.	⊙ tr. Pl.
	− +	+ −	+ −	+ −	+ −	+ −	+ −	− +	− +	− +	− +	− +	
°	s.	s.	s	s.	s.	s.	s.	s.	s.	s.	s.	s.	°
6	1	3	6	8	7	5	8° 1 8°	3	6	8	8	5	6
12	10° 0 10°	4	7	8	7	5	− 0 +	4	7	8	7	4	12
18	+ 1 −	5	7	8	6	4	1	5	7	8	7	3	18
24	2	5	8	8	6	3	1	5	8	8	6	3	24
30	2	6	8	8	5	2	2	6	8	8	5	2	30

N. B. The above Seconds of Time are the Differences of Seconds in the 2d Equa^n Time Page 20, in Succession from 1st Diff.

Construction. *To find the absolute Equation of Time to the Sun's true Place* ♊ 16° ?

By Tab. p. 20 . . Sun's Pl. ♊ 16°	2ˢ 16° 0′ 0″	− 4ᵐ 50ˢ 1st Equa^n Time.	The Reason of the Signs in the lower
Pl. Sun's Apog. from above . .	3 9 3 0 −	+ 3 3 2d Equa^n Time. p. 20.	Tab. shall be shewn hereafter.
True Anom. Sun	11 7 0 0	− 1 47 Abs. Equa^n of A. to M. Time, required.	
By Tab. p. 17 . . . . . Equation	− 0 45 47		
Correspondent M. An. Sun . . .	11 6 14 13		

To find the abs. Equation of Time *for Sun's true Pl.* ♏ 18° *and* 22′ *Incr. or Decr. Sun's* Ap. from ♋ 9° ?

By Tab. above Sun's Pl. ♏ 18° . . . . abs. Eq^n. − | A m s M: 15 50 + |

60′ : 5ˢ :: 22′ : 2ˢ ♏ 18°. . Subord. Eq. { Inc. − / Dec. + } | . . 2 | Hence { A m s M: − 15 52 + / − 15 48 + } Equat. req^d.

I. EQUATION

I. Equation of TIME; of App^t to Mean and Mean to App^t.

Argument. SUN's true place.

⊙ tr. Pl.	♈ ♎ 0 6 A. M. − +		Diff.	♉ ♏ 1 7 A. M. − +		Diff.	♊ ♐ 2 8 A. M. − +		Diff.	⊙ tr. Pl.
°	m	s	s	m	s	s	m	s	s	°
0	0	0		8	23		8	45		30
1	0	20	20	8	33	10	8	35	10	29
2	0	40	20	8	43	10	8	24	11	28
3	0	59	19	8	52	9	8	13	11	27
4	1	19	20	9	1	9	8	0	13	26
5	1	39	20	9	9	8	7	48	12	25
6	1	58	19	9	17	8	7	34	14	24
7	2	18	20	9	24	7	7	20	14	23
8	2	37	19	9	30	6	7	5	15	22
9	2	56	19	9	35	5	6	50	15	21
10	3	15	19	9	40	5	6	35	15	20
11	3	34	19	9	44	4	6	18	17	19
12	3	52	18	9	47	3	6	1	17	18
13	4	10	18	9	50	3	5	44	17	17
14	4	28	18	9	52	2	5	26	18	16
15	4	46	18	9	53	1	5	8	18	15
16	5	3	17	9	54	1	4	50	18	14
17	5	20	17	9	54	0	4	31	19	13
18	5	37	17	9	53	1	4	11	20	12
19	5	53	16	9	51	2	3	52	19	11
20	6	9	16	9	49	2	3	32	20	10
21	6	25	16	9	46	3	3	11	21	9
22	6	40	15	9	42	4	2	51	20	8
23	6	55	15	9	37	5	2	30	21	7
24	7	9	14	9	32	5	2	9	21	6
25	7	23	14	9	26	6	1	48	21	5
26	7	36	13	9	19	7	1	25	22	4
27	7	48	12	9	13	6	1	5	21	3
28	8	0	12	9	4	9	0	43	22	2
29	8	12	12	8	55	9	0	22	21	1
30	8	23	11	8	45	10	0	0	22	0
⊙ tr. Pl.	+ − A. M. 11 5 ♓ ♍		Diff.	+ − A. M. 10 4 ♒ ♌		Diff.	+ − A. M. 9 3 ♑ ♋		Diff.	⊙ tr. Pl.

Construction. The above *Table* is the *Diff.* between the Sun's true Long. and the R. A. converted into Time, which *adds* to App^t in the 2d and 4th *Quadratures*, and subtracts therefrom in the 1st and 2d *Quadratures*, for the *M. Time* and the *contrary*.

N. B. The Complement of any Diff. to 60′ of Deg. R. A. (in Tab. R. A.) converted into Time, and *added* to the Equat. of T. for any preceding Deg. ⊙ tr. Place, as far as ♉ 17°, or *great Equat.* Time, will b the Equat. T. in the above Tab. corresp. t the succeeding Deg. of ⊙ true Place—But the Diff. of R. A. above 60′ beyond ♉ 17°, or the greatest Equat. converted into Time, and *subducted* fr. the Equat. of T. for any preceding Deg. ⊙ true Pl. will be the Equat. T. corresponding to the succeeding Deg. thereof.

II. Equation of TIME; of Apparent to Mean and Mean to Apparent.

Argument. SUN's Mean Anomaly.

⊙ M. An.	Sig. 0 A. M. − +		Diff.	Sig. 1 A. M. − +		Diff.	Sig. 2 A. M. − +		Diff.	Sig. 3 A. M. − +		Diff.	Sig. 4 A. M. − +		Diff.	Sig. 5 A. M. − +		Diff.	⊙ M. An.
°	m	s	s	m	s	s	m	s	s	m	s	s	m	s	s	m	s	s	°
0	0	0		3	47		6	37		7	43		6	45		3	56		30
1	0	8	8	3	54	7	6	41	4	7	43	0	6	41	4	3	49	7	29
2	0	16	8	4	1	7	6	45	4	7	43	0	6	37	4	3	42	7	28
3	0	24	8	4	8	7	6	49	4	7	43	0	6	33	4	3	34	8	27
4	0	32	8	4	15	7	6	53	4	7	43	0	6	29	4	3	27	7	26
5	0	40	8	4	21	6	6	56	3	7	42	1	6	24	5	3	20	7	25
6	0	47	7	4	28	7	7	0	4	7	42	0	6	20	4	3	12	8	24
7	0	55	8	4	34	6	7	3	3	7	41	1	6	15	5	3	5	7	23
8	1	3	8	4	41	7	7	6	3	7	40	1	6	10	5	2	57	8	22
9	1	11	7	4	47	6	7	9	3	7	39	1	6	5	5	2	49	8	21
10	1	19	8	4	53	6	7	12	3	7	38	1	6	0	5	2	42	7	20
11	1	27	8	4	59	6	7	15	3	7	37	1	5	55	5	2	34	8	19
12	1	34	7	5	5	6	7	18	3	7	35	2	5	49	6	2	26	8	18
13	1	42	8	5	11	6	7	20	2	7	34	1	5	44	5	2	18	8	17
14	1	50	8	5	17	6	7	23	3	7	32	2	5	38	6	2	10	8	16
15	1	58	8	5	23	6	7	25	2	7	30	2	5	33	5	2	2	8	15
16	2	5	7	5	28	5	7	27	2	7	28	2	5	27	6	1	54	8	14
17	2	13	8	5	34	6	7	29	2	7	26	2	5	21	6	1	46	8	13
18	2	20	7	5	39	5	7	31	2	7	23	3	5	15	6	1	38	8	12
19	2	28	8	5	45	6	7	33	2	7	21	2	5	9	6	1	30	8	11
20	2	35	7	5	50	5	7	35	2	7	19	2	5	3	6	1	22	8	10
21	2	43	8	5	55	5	7	36	1	7	16	3	4	56	7	1	14	8	9
22	2	50	7	6	0	5	7	37	1	7	13	3	4	50	6	1	6	8	8
23	2	58	8	6	5	5	7	39	2	7	10	3	4	44	6	0	58	8	7
24	3	5	7	6	10	5	7	40	1	7	7	3	4	37	7	0	49	9	6
25	3	12	7	6	15	5	7	41	1	7	4	3	4	30	7	0	41	8	5
26	3	19	7	6	20	5	7	41	0	7	0	4	4	24	6	0	33	8	4
27	3	26	7	6	24	4	7	42	1	6	57	3	4	17	7	0	25	8	3
28	3	34	8	6	29	5	7	43	1	6	53	4	4	10	7	0	17	8	2
29	3	41	7	6	33	4	7	43	0	6	49	4	4	3	7	0	8	9	1
30	3	47	6	6	37	4	7	43	0	6	45	4	3	56	7	0	0	8	0
⊙ M. An.	+ − A. M. 11 Sig.		Diff.	+ − A. M. 10 Sig.		Diff.	+ − A. M. 9 Sig.		Diff.	+ − A. M. 8 Sig.		Diff.	+ − A. M. 7 Sig.		Diff.	+ − A. M. 6 Sig.		Diff.	⊙ M. An.

Construction. The above *Table* is only the Equation of the Sun's Center, correspondent to the given *Mean Anomaly*, converted into Time, which subtracts from the Apparent in the *1st Six Signs*, and adds thereto in the *last Six Signs*, for the Mean Time, and the contrary.—Hence *the Sum of the* Ist and IId *Equations for the absolute Equation of Time, will be always equal to the Diff. of the* ⊙*'s R. A. and his Mean Longitude converted into Time.*

N. B. *Mean Time* is considered in *Apparent Time* correspondent to it.

Example. To *find the Mean Time, or Hour correspondent to Apparent Noon, the* ⊙*'s true Place being* ♑ 23°. 25′. and ⊙ *Mean Anom.* 5^s. 15°. 56′ ?

By *Table* I. ♑ 23° 25′ . . A to M . . + 7^m 26^s
By *Table* II. 5^s 15° 56′ . . A to M . . + 1 54

Sum + 9 20
Noon 12 0 0

Hours 12 9 20 *required.*
Mean Time correspondent to Apparent Time in the Afternoon.

Refraction of Light (Lat. *Greenwich Observatory*), and **Parallax of the Sun.** The *first* to be subtracted from the apparent Altitude of the *luminous Body*, and the *latter* to be added to the apparent for the *real Altitude* of the Sun.

Argument. Apparent Altitude of the Sun.

Ap. Alt. ☉.	Re-fracn. —	Par. ☉. +	Ap. Alt. ☉.	Re-fracn. —	Par. ☉. +	Ap. Alt. ☉.	Ref. ☉. —	Par. ☉. +
°	′ ″	″	°	′ ″	″	°	″	″
0	33 45	10	21	2 28	9	56	36	6
¼	30 24	10	22	2 11	9	57	35	6
½	27 35	10	23	2 5	9	58	34	5
¾	25 11	10	24	1 59	9	59	32	5
1	23 7	10	25	1 54	9	60	31	5
1¼	21 20	10	26	1 49	9	61	30	5
1½	19 46	10	27	1 44	9	62	28	5
1¾	18 22	10	28	1 40	9	63	27	5
2	17 8	10	29	1 36	9	64	26	4
2½	15 2	10	30	1 32	9	65	25	4
3	13 20	10	31	1 28	9	66	24	4
3½	11 57	10	32	1 25	9	67	23	4
4	10 48	10	33	1 22	8	68	22	4
4½	9 50	10	34	1 19	8	69	21	3
5	9 2	10	35	1 16	8	70	20	3
5½	8 21	10	36	1 13	8	71	19	3
6	7 45	10	37	1 11	8	72	18	3
6½	7 14	10	38	1 8	8	73	17	2
7	6 47	10	39	1 6	8	74	16	2
7½	6 22	10	40	1 4	8	75	15	2
8	6 0	10	41	1 2	8	76	14	2
8½	5 40	10	42	1 0	8	77	13	2
9	5 22	10	43	58	7	78	12	2
9½	5 6	10	44	56	7	79	11	2
10	4 52	10	45	54	7	80	10	2
11	4 27	10	46	52	7	81	9	1
12	4 5	10	47	50	7	82	8	1
13	3 47	10	48	47	7	83	7	1
14	3 31	10	49	47	7	84	6	1
15	3 17	10	50	45	7	85	5	1
16	3 4	10	51	44	6	86	4	1
17	2 53	10	52	42	6	87	3	1
18	2 43	10	53	40	6	88	2	0
19	2 34	10	54	39	6	89	1	0
20	2 26	9	55	38	6	90	0	0

The *Refraction* of Light varies with the Latitude, Atmosphere, or Weather; especially near the *Horizon.* — In the Year 1695, in Latitude 65° 53′, on June 14, 12 Hours P. M. the Sun's Center being depressed below the Horizon 40′, at *Pello*, 10 Miles northward of *Forneo* in Western *Bothnia*, He was observed, by Refraction, to be two Diameters in Altitude, or above 1°. — The common Experiment of pouring Water upon a *Piece of Silver*, in a Bason, to bring it in Sight (when unseen before) proves the Elevation of Objects by Light passing from them through a denser to a rarer *Medium*, (the contrary happening from a rarer to a denser) as on the Variation of the refracting *Medium* the different Degrees of Refraction depend.

Rays passing through Oil of *Turpentine* and through *Water*, give the Degrees of Refraction different, proving the different Densities of those *Mediums*.

Parallax of the Sun is the Angle the Sun is seen lower from the Earth's Surface than it would be seen from its Center.

Hourly Motion, and Apparent *Semi-Diameter* of the Sun.

Arg. Sun's Mean Anomaly.

☉'s Mean Anom.		Hourly Mot. ☉.		Semi-Diam. ☉.		☉'s Mean Anom.	
s	°	′	″	′	″	°	s
0	0	2	23	15	51	0	12
	6	2	23	15	51	24	
	12	2	23	15	52	18	
	18	2	23	15	52	12	
	24	2	23	15	53	6	
1	0	2	24	15	53	0	11
	6	2	24	15	54	24	
	12	2	24	15	55	18	
	18	2	24	15	57	12	
	24	2	25	15	58	6	
2	0	2	25	15	59	0	10
	6	2	26	16	1	24	
	12	2	26	16	2	18	
	18	2	27	16	4	12	
	24	2	27	16	6	6	
3	0	2	28	16	7	0	9
	6	2	28	16	9	24	
	12	2	29	16	11	18	
	18	2	29	16	13	12	
	24	2	30	16	14	6	
4	0	2	30	16	16	0	8
	6	2	31	16	17	24	
	12	2	31	16	18	18	
	18	2	32	16	20	12	
	24	2	32	16	21	6	
5	0	2	32	16	22	0	7
	6	2	32	16	23	24	
	12	2	33	16	23	18	
	18	2	33	16	24	12	
	24	2	33	16	24	6	
6	0	2	33	16	24	0	0

Construction. *To find the Sun's hourly Motion correspondent to* 4s 6°, *Sun's Mean Anomaly?*

By Equation Tab. Sun's Center, p. 12
4s 6° M. An. + 1′ 10″ dif. Eq. 24h.
+ 59 8 M. Mo. 24 H.
Sun's tr. Mo. in 24h 60 18 fere.
Whence 2 31 Hourly Mo. (as by Table) required.

To find ☉*'s Apt. Sem. Diam. corresp. to* 6s *M. An. the Apt. S. Diam. to* 0s *M. An. being given* 15′ 51″?

By Tab. L. Sun's propl Dist. fr. ⊖. p. 16
Reciprocally. [Co.
0s M. An. Pr. D. ☉ 101685 .. L. 4,9927
Sun's ap. S. Diam. 15′ 51″ .. L. L. 0,5781
6s M. An. Pr. D. ☉, 98316 . . L. 4,9926
Sun's ap. S. Diam. 16′ 24″ .. L. L. 0,5634 (as by Tab.) reqd. The ap. S. Diam. or Diam. being recip. as Sun's Dist. à ⊖.

Acceleration of the *fixed* ✻s according to *mean* solar *Parts of Time.*

Arg. Days.

Ds.	*Acceleration.*		
No.	h	m	s
1	0	3	56
2	0	7	52
3	0	11	48
4	0	15	44
5	0	19	39
6	0	23	35
7	0	27	31
8	0	31	27
9	0	35	23
10	0	37	19
11	0	43	15
12	0	47	11
13	0	51	7
14	0	55	3
15	0	58	58
16	1	2	54
17	1	6	50
18	1	10	46
19	1	14	42
20	1	18	38
21	1	22	34
22	1	26	30
23	1	30	26
24	1	34	22
25	1	38	17
26	1	42	13
27	1	46	9
28	1	50	5
29	1	54	1
30	1	57	57
31	2	1	53

The *fixed* Stars come, in mean Time, as above, sooner to the Meridian, each Day, than on the preceding Day.

The true Time of the *fixed* Stars Acceleration is the *Increase* of the Sun's R. A. each Day converted into Time. *See Tab. P.* 24, 25, 26, 27.

Req. Sun's true Alt. to 15° *ap. Alt.?*
15° 0′ 0″
Eq. Ref. — 3 17
Eq. Paral. + 10
☉ tr. Alt. 14 56 53

DECIMALS of a DEGREE, for proportioning SEXAGESIMAL QUANTITIES.

MINUTES.				SECONDS.				THIRDS.			
Min.	Decim.	Min.	Decim.	Sec.	Decim.	Sec.	Decim.	Th^s.	Decim.	Th^s.	Decim.
1	,0166	31	,5166	1	,00027	31	,00861	1	,000004629	31	,000143518
2	,0333	32	,5333	2	,00055	32	,00888	2	,000009259	32	,000148148
3	,05.	33	,55.	3	,00083	33	,00916	3	,00001388	33	,00015277
4	,0666	34	,5666	4	,00111	34	,00944	4	,000018518	34	,000157407
5	,0833	35	,5833	5	,00138	35	,00972	5	,000023148	35	,000162037
6	,1.	36	,6.	6	,00166	36	,01.	6	,00002777	36	,00016666
7	,1166	37	,6166	7	,00194	37	,01027	7	,000032407	37	,000171296
8	,1333	38	,6333	8	,00222	38	,01055	8	,000037037	38	,000175925
9	,15.	39	,65.	9	,0025.	39	,01083	9	,000041666	39	,00018055
10	,1666	40	,6666	10	,00277	40	,01111	10	,000046296	40	,000185185
11	,1833	41	,6833	11	,00305	41	,01138	11	,000050925	41	,000189814
12	,2.	42	,7.	12	,00333	42	,01166	12	,00005555	42	,00019444
13	,2166	43	,7166	13	,00361	43	,01194	13	,000060185	43	,000199074
14	,2333	44	,7333	14	,00388	44	,01222	14	,000064814	44	,000203703
15	,25.	45	,75.	15	,00416	45	,0125.	15	,00006944	45	,00020833
16	,2666	46	,7666	16	,00444	46	,01277	16	,000074074	46	,000212962
17	,2833	47	,7833	17	,00472	47	,01305	17	,000078703	47	,000217592
18	,3.	48	,8.	18	,005.	48	,01333	18	,00008333	48	,00022222
19	,3166	49	,8166	19	,00527	49	,01361	19	,000087962	49	,000226851
20	,3333	50	,8333	20	,00555	50	,01388	20	,000092592	50	,000231481
21	,35.	51	,85.	21	,00583	51	,01416	21	,00009722	51	,00023611
22	,3666	52	,8666	22	,00611	52	,01444	22	,000101851	52	,000240740
23	,3833	53	,8833	23	,00638	53	,01472	23	,000106481	53	,000245370
24	,4.	54	,9.	24	,00666	54	,015.	24	,00011111	54	,00025.
25	,4166	55	,9166	25	,00694	55	,01527	25	,000115740	55	,000254629
26	,4333	56	,9333	26	,00722	56	,01555	26	,000120370	56	,000259259
27	,45.	57	,95.	27	,0075.	57	,01583	27	,000125.	57	,00026388
28	,4666	58	,9666	28	,00777	58	,01611	28	,000129629	58	,000268518
29	,4833	59	,9833	29	,00805	59	,01638	29	,000134259	59	,000273148
30	,5.	60	1.	30	,00833	60	,01666	30	,00013888	60	,00027777

N. B. In the above Table, *the* Figure *with a fine Stroke cross it, denotes a continual Repetition of the Figure or Figures from that Place. And a* Dot (.) *or* Full Point, *after a* Decimal, *denotes its exact Value.*

EXAMPLE. As 3° 19′ 23″ is to 40° 29′ 33″ 40‴, so is 11° 49′ 34″ 18‴, to 144° 6′ 23″ 56‴, &c.

By the Table
19′ = ,316666 . : As 3°,323055 (,3833) to 40°,4926851 (,66 ,56111) so 11°,826194 (,3 ,57166)
23″ = ,006388

,323055

29′ = ,4833333
33″ = ,0091666
40‴ = ,0001851

,4926851

49′ = ,8166666
34″ = ,0094444
18‴ = ,0000833

,8261944

By . . .	Logarithms	
As 3°,323055 .	9.4784624 co.	[to 144°,10665, &c. *Decimally.*
To 40,4926851	1.6073765	6′,399
So 11,826194 .	1.0728450	23″,94
		56‴,4
To 144°,1066	2.1586839	

The greater Ease and Expedition of finding the Decimals *to* Sexagesimals, *by dividing them and their Quotients, from inferior Order, by* 6, *than finding the same by the Table, appear from the* Examples *above, and on the Side.*

SUN's DECLINATION from the EQUINOCTIAL, and MERIDIAN ANGLE with the ECLIPTIC. According to the Mean Ecliptic Obliquity 23° 28′ ½.

Argument. SUN's true PLACE in the ECLIPTIC.

⊙ tr. Pl	Aries ♈ 0, Libra ♎ 6 Sig.				Taurus ♉ 1, Scorpio ♏ 7 Sig.				Gemini ♊ 2, Sagittarius ♐ 8 Sig.				⊙ tr. Pl
	⊙ Declin.	Diff.	Merid. ∠.	Diff.	⊙ Declin.	Diff.	Merid. ∠.	Diff.	⊙ Declin.	Diff.	Merid. ∠.	Diff.	
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	23 54	66 31 30	0 11	11 29 19	21 2	69 23 18	11 36	20 10 50	12 33	77 44 55	21 41	30
1	0 23 54	23 54	66 31 41	0 35	11 50 21	20 50	69 34 54	11 58	20 23 23	12 10	78 6 36	21 58	29
2	0 47 48	23 52	66 32 16	0 57	12 11 11	20 38	69 46 52	12 20	20 35 33	11 47	78 28 34	22 13	28
3	1 11 40	23 52	66 33 13	1 21	12 31 49	20 27	69 59 12	12 44	20 47 21	11 25	78 50 47	22 28	27
4	1 35 32	23 51	66 34 34	1 43	12 52 16	20 12	70 11 56	13 5	20 58 46	11 2	78 13 15	22 44	26
5	1 59 23	23 48	66 36 17	2 6	13 12 28	20 0	70 25 1	13 27	21 9 48	10 38	79 35 59	22 58	25
6	2 23 11	23 46	66 38 23	2 30	13 32 28	19 47	70 38 28	13 49	21 20 26	10 14	79 58 57	23 11	24
7	2 46 57	23 44	66 40 53	2 52	13 52 15	19 32	70 52 17	14 11	21 30 40	9 50	80 22 8	23 26	23
8	3 10 41	23 41	66 43 45	3 15	14 11 47	19 19	71 6 28	14 32	21 40 30	9 26	80 45 34	23 39	22
9	3 34 22	23 37	66 47 0	3 38	14 31 6	19 4	71 21 0	14 54	21 49 56	9 2	81 9 13	23 51	21
10	3 57 59	23 34	66 50 38	4 1	14 50 10	18 49	71 35 54	15 16	21 58 58	8 36	81 33 4	24 4	20
11	4 21 33	23 30	66 54 39	4 24	15 8 59	18 33	71 51 10	15 37	22 7 34	8 11	81 57 8	24 15	19
12	4 45 3	23 25	66 59 3	4 47	15 27 32	18 18	72 6 47	15 58	22 15 45	7 46	82 21 23	24 26	18
13	5 8 28	23 20	67 3 50	5 9	15 45 50	18 2	72 25 45	16 19	22 23 31	7 21	82 45 49	24 37	17
14	5 31 48	23 16	67 8 59	5 33	16 3 52	17 45	72 39 4	16 39	22 30 52	6 55	83 10 26	24 46	16
15	5 55 4	23 10	67 14 32	5 55	16 21 37	17 28	72 55 43	17 1	22 37 47	6 29	83 35 12	24 56	15
16	6 18 14	23 3	67 20 27	6 19	16 39 5	17 11	73 12 44	17 21	22 44 16	6 3	84 0 8	25 5	14
17	6 41 17	22 58	67 26 46	6 41	16 56 16	16 54	73 30 5	17 41	22 50 19	5 37	84 25 13	25 12	13
18	7 4 15	22 51	67 33 27	7 4	17 13 10	16 35	73 47 46	18 2	22 55 56	5 11	84 50 25	25 21	12
19	7 27 6	22 54	67 40 31	7 29	17 29 45	16 18	74 5 48	18 22	23 1 7	4 44	84 15 46	25 28	11
20	7 49 50	22 36	67 47 58	7 49	17 46 3	15 58	74 24 10	18 40	23 5 51	4 17	85 41 14	25 34	10
21	8 12 26	22 29	67 55 47	8 14	18 2 1	15 39	74 42 50	19 0	23 10 8	3 51	86 6 48	25 40	9
22	8 34 55	22 21	68 4 1	8 35	18 17 40	15 21	75 1 50	19 19	23 13 59	3 24	86 32 28	25 45	8
23	8 57 16	22 12	68 12 36	8 58	18 33 1	15 0	75 21 9	19 39	23 17 23	2 56	86 58 13	25 50	7
24	9 19 28	22 3	68 21 34	9 21	18 48 1	14 40	75 40 48	19 57	23 20 19	2 30	87 24 3	25 54	6
25	9 41 31	21 54	68 30 55	9 43	19 2 41	14 20	76 0 45	20 14	23 22 49	2 3	87 49 57	25 57	5
26	10 3 25	21 44	68 40 38	10 6	19 17 1	14 0	76 20 59	20 33	23 24 52	1 35	88 15 54	25 59	4
27	10 25 9	21 35	68 50 44	10 29	19 31 1	13 38	76 41 32	20 51	23 26 27	1 8	88 41 53	26 1	3
28	10 46 44	21 23	69 1 13	10 52	19 44 39	13 16	77 2 23	21 7	23 27 35	0 41	89 7 54	26 3	2
29	11 8 7	21 12	69 12 5	11 13	19 57 55	12 55	77 23 30	21 25	23 28 16	0 14	89 33 57	26 3	1
30	11 29 19		69 23 18		20 10 50		77 44 55		23 28 30		90 0 0		0
⊙ tr. Pl	⊙ Decl.	Dif.	Merid. ∠.	Dif.	⊙ Decl.	Dif.	Merid. ∠.	Diff.	⊙ Decl.	Dif.	Merid. ∠	Dif.	⊙ Pl
	Virgo ♍ 5, Pisces ♓ 11 Sig.				Leo ♌ 4, Aquarius ♒ 10 Sig.				Cancer ♋ 3, Capricorn ♑ 9 Sig.				

EXAMPLE I. *To find the Sun's Declination correspondent to* ♉, 15° *Longitude?*

	Com. Logs.		
As Radius . . . . S.	10,0000000	*Hence*, To constant Log.	9,6002636
To Long. of Sun 45° . . . S.	9,8494850	Add S. Long. Sun from ♈ or ♎ .	. . . . .
So greatest Decⁿ 23° 28′ ½ . S.	9,6002636		
To present Decⁿ 16° 21′ 37″ S.	9,4497486	Sum (rejecting Rad.) will be S. the present Declination.	. . . . .

EXAMPLE II. *To find the Meridian Angle correspondent to* ♊ 20°?

As Radius . . . . S.	10,0000000	Hence, To constant Log.	9,6377835
To Long. Sun 80° . . . Cos.	9,2396702	Add Cos. Sun's Long. from ♈ or ♎	. . . . . .
So gr. Declⁿ 23° 28′ ½ Tang.	9,6377835		
To Merid. ∠ 85° 41′ 14″ Co. Tan.	8,8774537	Sum (rejecting Rad.) will be the Co. Tan. Merid. ∠ .	. . . . . .

N. B. When the Sun's Longitude is above 90°, then the Supplement to 180° must be taken, and the Complement of that Supplement used. Or, S. ⊙ Long. : Rad. :: S. R. A. ⊙ : S. Meridian ∠.

SUN's Right Ascension, from *Aries*, according to the Mean *Ecliptic* Obliquity 23° 28′ ½.

Argument. SUN's PLACE in the ECLIPTIC.

⊙ Pl.	♈ 0ˢ	Diff.	♉ 1ˢ	Diff.	♊ 2ˢ	Diff.	♋ 3ˢ	Diff.	♌ 4ˢ	Diff.	♍ 5ˢ	Diff.	⊙ Pl.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	55 2	27 54 15	57 23	57 48 42	62 34	90 0 0	65 25	122 11 18	62 23	152 5 45	57 14	30
1	0 55 2	55 3	28 51 38	57 31	58 51 16	62 43	91 5 25	65 24	123 13 41	62 12	153 2 59	57 6	29
2	1 50 5	55 3	29 49 9	57 41	59 53 59	62 53	92 10 49	65 24	124 15 53	62 3	154 0 5	56 58	28
3	2 45 8	55 4	30 46 50	57 50	60 56 52	63 2	93 16 13	65 22	125 17 56	61 51	154 57 3	56 50	27
4	3 40 12	55 5	31 44 40	57 59	61 59 54	63 13	94 21 35	65 20	126 19 47	61 41	155 53 53	56 42	26
5	4 35 17	55 7	32 42 39	58 9	63 3 7	63 22	95 26 55	65 18	127 21 28	61 30	156 50 35	56 34	25
6	5 30 24	55 8	33 40 48	58 18	64 6 29	63 30	96 32 13	65 15	128 22 58	61 19	157 47 9	56 28	24
7	6 25 32	55 11	34 39 6	58 29	65 9 59	63 39	97 37 28	65 12	129 24 17	60 9	158 43 37	56 21	23
8	7 20 43	55 14	35 37 35	58 38	66 13 38	63 48	98 42 40	65 9	130 25 26	60 57	159 39 58	56 14	22
9	8 15 57	55 16	36 36 13	58 49	67 17 26	63 56	99 47 49	65 5	131 26 23	60 47	160 36 12	56 7	21
10	9 11 13	55 20	37 35 2	58 58	68 21 22	64 4	100 52 54	65 0	132 27 10	60 36	161 32 19	56 1	20
11	10 6 33	55 23	38 34 0	59 10	69 25 26	64 12	101 57 54	64 56	133 27 46	60 24	162 28 21	55 55	19
12	11 1 56	55 27	39 33 10	59 20	70 29 38	64 19	103 2 50	64 51	134 28 10	60 14	163 24 16	55 50	18
13	11 57 23	55 31	40 32 30	59 30	71 33 57	64 26	104 7 41	64 44	135 28 24	60 3	164 20 6	55 46	17
14	12 52 54	55 35	41 32 0	59 41	72 38 23	64 33	105 12 25	64 39	136 28 27	59 52	165 15 52	55 39	16
15	13 48 29	55 39	42 31 41	59 52	73 42 56	64 39	106 17 4	64 33	137 28 19	59 41	166 11 31	55 35	15
16	14 44 8	55 46	43 31 33	60 3	74 47 35	64 44	107 21 37	64 26	138 28 0	59 30	167 7 6	55 31	14
17	15 39 54	55 50	44 31 36	60 14	75 52 19	64 51	108 26 3	64 19	139 27 30	59 20	168 2 37	55 27	13
18	16 35 44	55 55	45 31 50	60 24	76 57 10	64 56	109 30 22	64 12	140 26 50	59 10	168 58 4	55 23	12
19	17 31 39	56 2	46 32 14	60 36	78 2 6	65 0	110 34 34	64 4	141 26 0	58 59	169 53 27	55 20	11
20	18 27 41	56 7	47 32 50	60 47	79 7 6	65 5	111 38 38	63 56	142 24 58	58 49	170 48 47	55 16	10
21	19 23 48	56 14	48 33 37	60 57	80 12 11	65 9	112 42 34	63 48	143 23 47	58 38	171 44 3	55 14	9
22	20 20 2	56 21	49 34 34	61 9	81 17 20	65 12	113 46 22	63 39	144 22 25	58 29	172 39 17	55 11	8
23	21 16 23	56 28	50 35 43	61 19	82 22 32	65 15	114 50 1	63 30	145 20 54	58 18	173 34 28	55 8	7
24	22 12 51	56 34	51 37 2	61 30	83 27 47	65 18	115 53 31	63 22	146 19 12	58 9	174 29 36	55 7	6
25	23 9 25	56 42	52 38 32	61 41	84 33 5	65 20	116 56 53	63 13	147 17 21	57 59	175 24 43	55 5	5
26	24 6 7	56 50	53 40 13	61 51	85 38 25	65 22	118 0 6	63 2	148 15 20	57 50	176 19 48	55 4	4
27	25 2 57	56 58	54 42 4	62 3	86 43 47	65 24	119 3 8	62 53	149 13 10	57 41	177 14 52	55 4	3
28	25 59 55	57 6	55 44 7	62 12	87 49 11	65 24	120 6 1	62 43	150 10 51	57 31	178 9 55	55 3	2
29	26 57 1	57 14	56 46 19	62 23	88 54 35	65 25	121 8 44	62 34	151 8 22	57 23	179 4 58	55 2	1
30	27 54 15		57 48 42		90 0 0		122 11 18		152 5 45		180 0 0		0
° ⊙ Pl	*Aries*	Diff.	*Taurus*	Diff.	*Gemini.*	Diff.	*Cancer.*	Diff.	*Leo.*	Diff.	*Virgo.*	Diff.	° ⊙ Pl.

Construction. As Rad. : Tang'. Long. ⊙ from next Equinoctial Point : : Cos. greatest Declination : to Tangᵗ. R. A.

EXAMPLE I. *To find the Sun's Right Ascension correspondent to* 80°. ⊙ *Longitude from* ♈ ?

	Com. Logˢ.		
: Rad. . . . S.	10.0000000	Hence to the *Const. Log.* :	9.9624801
: : 80° . . . T.	10.7536812	AddTang. Long. ⊙ from ♈.	. . . . .
: 23 28′ ½. C. S.	9.9624801	*Sum* (deductingR.)=T.R.A. [from ♈.	. . . . .
: 79° 7′ 6″ T.	10.7161613		

EXAMPLE II. *To find the* ⊙ *R. A. correspondent to* ♌ 28 ?

♌ 28° = 148° Supplᵗ. = 32°.

To Const. Log. 9.9624801
Add 32°. T. . 9.7957892
—29° 49′ 9″ T. 9.7582693
180
Difference 150 10 51 Right Ascension required.

N. B. Having found the Right Ascⁿ. to 90°. all the rest *easily* follow from thence to 180°: being the Supplements of the former *(taken backwards)* to 180°; *so that the R. A. of any Number of Signs and Degrees of the Sun's Place being given under* 90°. *the Supplement* thereof to 180° will be the Right Ascension to the *Supplement* of those Signs and Degrees to 6 Signs.

EXAMPLE.	2ˢ 12°	R. A.	70° 29′ 38″	
Supplement	3 18	R. A.	109 30 22	Supplement
	6 0		180 0 0	Proof.

SUN's Right Ascension, from *Aries*, according to the Mean *Ecliptic* Obliquity, 23° 28½′.

Argument. SUN's PLACE in the Ecliptic.

☉ Pl.	♎ 6s	Diff.	♏ 7s	Diff.	♐ 8s	Diff.	♑ 9s	Diff.	♒ 10s	Diff.	♓ 11s	Diff.	☉ Pl.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	180 0 0	55 2	207 54 15	57 23	237 48 42	62 34	270 0 0	65 25	302 11 18	62 23	332 5 45	57 14	30
1	180 55 2	55 3	208 51 38	57 31	238 51 16	62 43	271 5 25	65 24	303 13 41	62 12	333 2 59	57 6	29
2	181 50 5	55 4	209 49 9	57 41	239 53 59	62 53	272 10 49	65 24	304 15 53	62 3	334 0 5	56 58	28
3	182 45 8	55 4	210 46 50	57 50	240 56 52	63 2	273 16 13	65 22	305 17 56	61 51	334 57 3	56 50	27
4	183 40 12	55 5	211 44 40	57 59	241 59 54	63 13	274 21 35	65 20	306 19 47	61 41	335 53 53	56 42	26
5	184 35 17	55 7	212 42 39	58 9	243 3 7	63 22	275 26 55	65 18	307 21 28	61 30	336 50 35	56 34	25
6	185 30 24	55 8	213 40 48	58 18	244 6 29	63 30	276 32 13	65 15	308 22 58	61 19	337 47 9	56 28	24
7	186 25 32	55 11	214 39 6	58 29	245 9 59	63 39	277 37 28	65 12	309 24 17	61 9	338 43 37	56 21	23
8	187 20 43	55 14	215 37 35	58 38	246 13 38	63 48	278 42 40	65 9	310 25 26	60 57	339 39 58	56 14	22
9	188 15 57	55 16	216 36 13	58 49	247 17 26	63 56	279 47 49	65 5	311 26 23	60 47	340 36 12	56 7	21
10	189 11 13	55 20	217 35 2	58 59	248 21 22	64 4	280 52 54	65 0	312 27 10	60 36	341 32 19	56 1	20
11	190 6 33	55 23	218 34 0	59 10	249 25 26	64 12	281 57 54	64 56	313 27 46	60 24	342 28 21	55 55	19
12	191 1 56	55 27	219 33 10	59 20	250 29 38	64 19	283 2 50	64 51	314 28 10	60 14	343 24 16	55 50	18
13	191 57 23	55 31	220 32 30	59 30	251 33 57	64 26	284 7 41	64 44	315 28 24	60 3	344 20 6	55 46	17
14	192 52 54	55 35	221 32 0	59 41	252 38 23	64 33	285 12 25	64 39	316 28 27	59 52	345 15 52	55 39	16
15	193 48 29	55 39	222 31 41	59 52	253 42 56	64 39	286 17 4	64 33	317 28 19	59 41	346 11 31	55 35	15
16	194 44 8	55 46	223 31 33	60 3	254 47 35	64 44	287 21 37	64 26	318 28 0	59 30	347 7 6	55 31	14
17	195 39 54	55 50	224 31 36	60 14	255 52 19	64 51	288 26 3	64 19	319 27 30	59 20	348 2 37	55 27	13
18	196 35 44	55 55	225 31 50	60 24	256 57 10	64 56	289 30 22	64 12	320 26 50	59 10	348 58 4	55 23	12
19	197 31 39	56 1	226 32 14	60 36	258 2 6	65 0	290 34 34	64 4	321 26 0	58 59	349 53 27	55 20	11
20	198 27 41	56 7	227 32 50	60 47	259 7 6	65 5	291 38 38	63 56	322 24 58	58 49	350 48 47	55 16	10
21	199 23 48	56 14	228 33 37	60 57	260 12 11	65 9	292 42 34	63 48	323 23 47	58 38	351 44 3	55 14	9
22	200 20 2	56 21	229 34 34	61 9	261 17 20	65 12	293 46 22	63 39	324 22 25	58 29	352 39 17	55 11	8
23	201 16 23	56 28	230 35 43	61 19	262 22 32	65 15	294 50 1	63 30	325 20 44	58 18	353 34 28	55 8	7
24	202 12 51	56 34	231 37 2	61 30	263 27 47	65 18	295 53 31	63 22	326 19 12	58 9	354 29 36	55 7	6
25	203 9 25	56 42	232 38 32	61 41	264 33 5	65 20	296 56 53	63 13	327 17 21	57 59	355 24 43	55 5	5
26	204 6 7	56 50	233 40 13	61 51	265 38 25	65 22	298 0 6	63 2	328 15 20	57 50	356 19 48	55 4	4
27	205 2 57	56 58	234 42 4	62 3	266 43 47	65 24	299 3 8	62 53	329 13 10	57 41	357 14 52	55 4	3
28	205 59 55	57 6	235 44 7	62 12	267 49 11	65 24	300 6 1	62 43	330 10 51	57 31	358 9 55	55 3	2
29	206 57 1	57 14	236 46 19	62 23	268 54 35	65 25	301 8 44	62 34	331 8 22	57 23	359 4 58	55 2	1
30	207 54 15		237 48 42		270 0 0		302 11 18		332 5 45		360 0 0		0
° ☉ Pl.	*Libra.*	Diff.	*Scorpio.*	Diff.	*Sagittary.*	Diff.	*Capricorn.*	Diff.	*Aquarius.*	Diff.	*Pisces.*	Diff.	° ☉ Pl.

N. B. When the Sun is in the *first Quadrant* of the Ecliptic, ♈, ♉, ♊, (as in the First Example) the *Fourth Term*, or Arch, is the R. A. from *Aries*. When the Sun is in the *Second Quadrant*, ♋, ♌, ♍, then the Fourth Term, or Arc, must be deducted from 180° for the Sun's R. A. from ♈. When the Sun is in the *third Quadrant*, ♎, ♏, ♐, the Fourth Term, or Arc, must be added to 180°, for the Sun's R. A. from ♈. And when the Sun is in the *fourth Quadrant*, ♑, ♒, ♓, the Fourth Term, or Arc, must be deducted from 360°, for the Sun's R. A. from ♈.

EXAMPLE III. *To find the Sun's Right Ascension correspondent to* ♐ 12° ?
♐ 12° = 252° = 72° above 180°.

To const. Log	. .	9.9624801
Add 72° T.	. .	10.4882240
+ 70° 29′ 38″ T.		10.4507041
180		
Sum 250 29 38 R. A. required.		

EXAMPLE IV. *To find the Sun's Right Ascension correspondent to* ♓ 3° ?
♓ 3° = 333° = 153° above 180°; Supplement = 27°.

To const. Log.	. .	9.9624801
Add 27° T.	. . .	9.7071659
—25° 2′ 57″ T.		9.6696460
360		
Dif. 334 57 3 R. A. required.		

N. B. The Right Ascension to the first 6 Signs of the Sun's Place being found, the Right Ascension to the last 6 Signs follow, by adding 180° to the Right Ascension of the former.

RIGHT ASCENSION of the SUN in TIME, to the present Mean OBLIQUITY of the ECLIPTIC, 23° 28′½.

Argument. SUN's true PLACE in the ECLIPTIC.

☉ Pl.	♈ Sig. 0	Dif.	♉ Sig. 1.	Dif.	♊ Sig. 2	Dif.	♋ Sig. 3	Dif.	♌ Sig. 4	Dif.	♍ Sig. 5	Dif.	☉ Pl.
°	h m s	m s	h m s	m s	h m s	m s	h m s	m s	h m s	m s	h m s	m s	°
0	0 0 0	3 40	1 51 37	3 50	3 51 15	4 10	6 0 0	4 22	8 8 45	4 10	10 8 23	3 49	30
1	0 3 40	3 40	1 55 27	3 50	3 55 25	4 11	6 4 22	4 21	8 12 55	4 9	10 12 12	3 49	29
2	0 7 20	3 40	1 59 17	3 50	3 59 36	4 11	6 8 43	4 22	8 17 4	4 8	10 16 1	3 48	28
3	0 11 0	3 41	2 3 7	3 52	4 3 47	4 13	6 13 5	4 21	8 21 12	4 7	10 19 49	3 47	27
4	0 14 41	3 40	2 6 59	3 52	4 8 0	4 12	6 17 26	4 22	8 25 19	4 7	10 23 36	3 47	26
5	0 18 21	3 40	2 10 51	3 52	4 12 12	4 14	6 21 48	4 21	8 29 26	4 6	10 27 23	3 46	25
6	0 22 1	3 41	2 14 43	3 53	4 16 26	4 14	6 26 9	4 21	8 33 32	4 5	10 31 9	3 45	24
7	0 25 42	3 41	2 18 36	3 54	4 20 40	4 15	6 30 30	4 21	8 37 37	4 5	10 34 54	3 46	23
8	0 29 23	3 41	2 22 30	3 54	4 24 55	4 15	6 34 51	4 20	8 41 42	4 4	10 38 40	3 45	22
9	0 33 4	3 40	2 26 24	3 56	4 29 10	4 15	6 39 11	4 21	8 45 46	4 3	10 42 25	3 44	21
10	0 36 44	3 42	2 30 20	3 56	4 33 25	4 17	6 43 32	4 20	8 49 49	4 2	10 46 9	3 44	20
11	0 40 26	3 42	2 34 16	3 57	4 37 42	4 17	6 47 52	4 19	8 53 51	4 2	10 49 53	3 44	19
12	0 44 8	3 42	2 38 13	3 57	4 41 59	4 17	6 52 11	4 20	8 57 53	4 1	10 53 37	3 43	18
13	0 47 50	3 42	2 42 10	3 58	4 46 16	4 18	6 56 31	4 19	9 1 54	4 0	10 57 20	3 43	17
14	0 51 32	3 42	2 46 8	3 59	4 50 34	4 18	7 0 50	4 19	9 5 54	3 59	11 1 3	3 43	16
15	0 55 14	3 43	2 50 7	3 59	4 54 52	4 18	7 5 9	4 18	9 9 53	3 59	11 4 46	3 42	15
16	0 58 57	3 43	2 54 6	4 0	4 59 10	4 19	7 9 26	4 18	9 13 52	3 58	11 8 28	3 42	14
17	1 2 40	3 43	2 58 6	4 1	5 3 29	4 20	7 13 44	4 17	9 17 50	3 57	11 12 10	3 42	13
18	1 6 23	3 44	3 2 7	4 2	5 7 49	4 19	7 18 1	4 17	9 21 47	3 57	11 15 52	3 42	12
19	1 10 7	3 44	3 6 9	4 2	5 12 8	4 20	7 22 18	4 17	9 25 44	3 56	11 19 34	3 42	11
20	1 13 51	3 44	3 10 11	4 3	5 16 28	4 21	7 26 35	4 15	9 29 40	3 56	11 23 16	3 40	10
21	1 17 35	3 45	3 14 14	4 4	5 20 49	4 20	7 30 50	4 15	9 33 36	3 54	11 26 56	3 41	9
22	1 21 20	3 46	3 18 18	4 5	5 25 9	4 21	7 35 5	4 15	9 37 30	3 54	11 30 37	3 41	8
23	1 25 6	3 45	3 22 23	4 5	5 29 30	4 21	7 39 20	4 14	9 41 24	3 53	11 34 18	3 41	7
24	1 28 51	3 46	3 26 28	4 6	5 33 51	4 21	7 43 34	4 14	9 45 17	3 52	11 37 59	3 40	6
25	1 32 37	3 47	3 30 34	4 7	5 38 12	4 22	7 47 48	4 12	9 49 9	3 52	11 41 39	3 40	5
26	1 36 24	3 47	3 34 41	4 7	5 42 34	4 21	7 52 0	4 13	9 53 1	3 52	11 45 19	3 41	4
27	1 40 11	3 48	3 38 48	4 8	5 46 55	4 22	7 56 13	4 11	9 56 53	3 50	11 49 0	3 40	3
28	1 43 59	3 49	3 42 56	4 9	5 51 17	4 21	8 0 24	4 11	10 0 43	3 50	11 52 40	3 40	2
29	1 47 48	3 49	3 47 5	4 10	5 55 38	4 22	8 4 35	4 10	10 4 33	3 50	11 56 20	3 40	1
30	1 51 37		3 51 15		6 0 0		8 8 45		10 8 23		12 0 0		0
☉ Pl.	*Aries.*	Dif.	*Taurus.*	Dif.	*Gemini.*	Dif.	*Cancer.*	Dif.	*Leo.*	Dif.	*Virgo.*	Dif.	☉ Pl.

N. B. The Right Aſcenſion in Time being found, (in *Tab.* above) to the Degrees of Right Aſcenſion *(in the former Tables, p.* 24, 25) as far as 90°, the Right Aſcenſion from thence, in Time, to 180°, will be the *Complement* of the former Right Aſcenſion *(taken backwards)* to 12 Hours of Time, ſo that the Right Aſcenſion in Time to any Number of Signs and Degrees of the Sun's Place being given, the Complement thereof to 12 Hours will be the Right Aſcenſion in Time to the Supplement of thoſe Signs and Degrees of the Sun's Place to 6 Signs.

EXAMPLE	1ˢ 16°	R. A. 2ʰ 54ᵐ 6ˢ	
	4 14	9 5 54	
	6 0	12 0 0	Proof.

RIGHT

RIGHT ASCENSION of the SUN in TIME, to the present Mean Obliquity of the Ecliptic, 23° 28′½.

Argument. SUN's true Place in the Ecliptic.

☉ Pl.	♎ Sig. 6	Dif.	♏ Sig. 7	Dif.	♐ Sig. 8	Dif.	♑ Sig. 9	Dif.	♒ Sig. 10	Dif.	♓ Sig. 11	Dif.	☉ Pl.
°	h m s	m s	h m s	m s	h m s	m s	h m s	m s	h m s	m s	h m s	m s	°
0	12 0 0		13 51 37		15 51 15		18 0 0		20 8 45		22 8 23		30
1	12 3 40	3 40	13 55 27	3 50	15 55 25	4 10	18 4 22	4 22	20 12 55	4 10	22 12 12	3 39	29
2	12 7 20	3 40	13 59 17	3 50	15 59 36	4 11	18 8 43	4 21	20 17 4	4 9	22 16 1	3 49	28
3	12 11 0	3 40	14 3 7	3 50	16 3 47	4 11	18 13 5	4 22	20 21 12	4 8	22 19 49	3 48	27
4	12 14 41	3 41	14 6 59	3 52	16 8 0	4 13	18 17 26	4 21	20 25 19	4 7	22 23 36	3 47	26
5	12 18 21	3 40	14 10 51	3 52	16 12 12	4 12	18 21 48	4 22	20 29 26	4 7	22 27 23	3 47	25
6	12 22 1	3 40	14 14 43	3 52	16 16 26	4 14	18 26 9	4 21	20 33 32	4 6	22 31 9	3 46	24
7	12 25 42	3 41	14 18 36	3 53	16 20 40	4 14	18 30 30	4 21	20 37 37	4 5	22 34 54	3 45	23
8	12 29 23	3 41	14 22 30	3 54	16 24 55	4 15	18 34 51	4 21	20 41 42	4 5	22 38 40	3 46	22
9	12 33 4	3 41	14 26 24	3 54	16 29 10	4 15	18 39 11	4 20	20 45 46	4 4	22 42 25	3 45	21
10	12 36 44	3 40	14 30 20	3 56	16 33 25	4 15	18 43 22	4 21	20 49 49	4 3	22 46 9	3 44	20
11	12 40 26	3 42	14 34 16	3 56	16 37 42	4 17	18 47 52	4 20	20 53 51	4 2	22 49 53	3 44	19
12	12 44 8	3 42	14 38 13	3 57	16 41 59	4 17	18 52 11	4 19	20 57 53	4 2	22 53 37	3 44	18
13	12 47 50	3 42	14 42 10	3 57	16 46 16	4 17	18 56 31	4 20	21 1 54	4 1	22 57 20	3 43	17
14	12 51 32	3 42	14 46 8	3 58	16 50 34	4 18	19 0 50	4 19	21 5 54	4 0	23 1 3	3 43	16
15	12 55 14	3 42	14 50 7	3 59	16 54 52	4 18	19 5 9	4 19	21 9 53	3 59	23 4 46	3 43	15
16	12 58 57	3 43	14 54 6	3 59	16 59 10	4 18	19 9 26	4 18	21 13 52	3 59	23 8 28	3 42	14
17	13 2 40	3 43	14 58 6	4 0	17 3 29	4 19	19 13 44	4 18	21 17 50	3 58	23 12 10	3 42	13
18	13 6 23	3 43	15 2 7	4 1	17 7 49	4 20	19 18 1	4 17	21 21 47	3 57	23 15 52	3 42	12
19	13 10 7	3 44	15 6 9	4 2	17 12 8	4 19	19 22 18	4 17	21 25 44	3 57	23 19 34	3 42	11
20	13 13 51	3 44	15 10 11	4 2	17 16 28	4 20	19 26 35	4 17	21 29 40	3 56	23 23 16	3 42	10
21	13 17 35	3 44	15 14 14	4 3	17 20 49	4 21	19 30 50	4 15	21 33 36	3 56	23 26 56	3 40	9
22	13 21 20	3 45	15 18 18	4 4	17 25 9	4 20	19 35 5	4 15	21 37 30	3 54	23 30 37	3 41	8
23	13 25 6	3 46	15 22 23	4 5	17 29 30	4 21	19 39 20	4 15	21 41 24	3 54	23 34 18	3 41	7
24	13 28 51	3 45	15 26 28	4 5	17 33 51	4 21	19 43 34	4 14	21 45 17	3 53	23 37 59	3 41	6
25	13 32 37	3 46	15 30 34	4 6	17 38 12	4 21	19 47 48	4 14	21 49 9	3 52	23 41 39	3 40	5
26	13 36 24	3 47	15 24 41	4 7	17 42 34	4 22	19 52 0	4 12	21 53 1	3 52	23 45 19	3 40	4
27	13 40 11	3 47	15 38 48	4 7	17 46 55	4 21	19 56 13	4 13	21 56 53	3 52	23 49 0	3 41	3
28	13 43 59	3 48	15 42 56	4 8	17 51 17	4 22	20 0 24	4 11	22 0 43	3 50	23 52 40	3 40	2
29	13 47 48	3 49	15 47 5	4 9	17 55 38	4 21	20 4 35	4 11	22 4 33	3 50	23 56 20	3 40	1
30	13 51 37	3 49	15 51 15	4 10	18 0 0	4 22	20 8 45	4 10	22 8 23	3 50	24 0 0	3 40	0
☉ Pl.	*Libra.*	Dif.	*Scorpio.*	Dif.	*Sagittary.*	Dif.	*Capricorn.*	Dif.	*Aquarius.*	Dif.	*Pisces.*	Dif.	☉ Pl.

N. B. The Right Ascension in Time to the *first 6 Signs* of the Sun's Place being found (in *Table, p. 26*) to the Degrees of Right Ascension (in the former Tables, p. 24, 25) as far as 180°, the Right Ascension, in Time, to the last 6 Signs, will be had by adding 12 Hours to the Right Ascension of the foregoing Table.

EXAMPLE. *To find the Right Ascension in Time to the Sun's true Place ♎ 18° 27′ 47″?*

♎ 18°	$13^h\ 6^m\ 23^s$	Excess of the Sun's Place above Degrees	27′ 47″	0.3344
	+ 1 44	Dif. Time for 1 Degree more . .	$3^m\ 44^s$	1.2061
Ho.	13 8 7	R. A. required.	$1^m\ 44^s$	1.5405

} *Logistical Logarithms.*

For reducing PARTS of the EQUATOR into TIME.

Argument. Parts of the Equator.

° / ″	Ho. Min. / Min. Sec. / Sec. Th.		° / ″	Ho. Min. / Min. Sec. / Sec. Th.		°	Hrs. Mins.	
1	0	4	31	2	4	70	4	40
2	0	8	32	2	8	80	5	20
3	0	12	33	2	12	90	6	0
4	0	16	34	2	16	100	6	40
5	0	20	35	2	20	110	7	20
6	0	24	36	2	24	120	8	0
7	0	28	37	2	28	130	8	40
8	0	32	38	2	32	140	9	20
9	0	36	39	2	36	150	10	0
10	0	40	40	2	40	160	10	40
11	0	44	41	2	44	170	11	20
12	0	48	42	2	48	180	12	0
13	0	52	43	2	52	190	12	40
14	0	56	44	2	56	200	13	20
15	1	0	45	3	0	210	14	0
16	1	4	46	3	4	220	14	40
17	1	8	47	3	8	230	15	20
18	1	12	48	3	12	240	16	0
19	1	16	49	3	16	250	16	40
20	1	20	50	3	20	260	17	20
21	1	24	51	3	24	270	18	0
22	1	28	52	3	28	280	18	40
23	1	32	53	3	32	290	19	20
24	1	36	54	3	36	300	20	0
25	1	40	55	3	40	310	20	40
26	1	44	56	3	44	320	21	20
27	1	48	57	3	48	330	22	0
28	1	52	58	3	52	340	22	40
29	1	56	59	3	56	350	23	20
30	2	0	60	4	0	360	24	0

EXAMPLE.

To find the Hours in 230°. 15′. 16″?

230°. = 15h. 20m.
15′. = 1
16″. = 0 1s. 4th.

Sum, 15 21 1 4 Answer.

For reducing TIME into PARTS of the EQUATOR.

Argument. Hours, Minutes, Seconds, &c. of Time.

Hours.	°	M. / Secs. / Ths.	° ′ / ′ ″ / ″ ‴		Mins. / Secs. / Ths.	° ′ / ′ ″ / ″ ‴	
1	15	1	0	15	31	7	45
2	30	2	0	30	32	8	0
3	45	3	0	45	33	8	15
4	60	4	1	0	34	8	30
5	75	5	1	15	35	8	45
6	90	6	1	30	36	9	0
7	105	7	1	45	37	9	15
8	120	8	2	0	38	9	30
9	135	9	2	15	39	9	45
10	150	10	2	30	40	10	0
11	165	11	2	45	41	10	15
12	180	12	3	0	42	10	30
13	195	13	3	15	43	10	45
14	210	14	3	30	44	11	0
15	225	15	3	45	45	11	15
16	240	16	4	0	46	11	30
17	255	17	4	15	47	11	45
18	270	18	4	30	48	12	0
19	285	19	4	45	49	12	15
20	300	20	5	0	50	12	30
21	315	21	5	15	51	12	45
22	330	22	5	30	52	13	0
23	345	23	5	45	53	13	15
24	360	24	6	0	54	13	30
		25	6	15	55	13	45
		26	6	30	56	14	0
		27	6	45	57	14	15
		28	7	0	58	14	30
		29	7	15	59	14	45
		30	7	30	60	15	0

EXAMPLE.

To find the Degrees in 15h. 21m. 1s. 4th. of Time?

15h. = 225°.
21m. = 5 15′.
1s. = 0 0 15″.
4th. = ... 1

Sum, 230 15 16 Ans.

REFRACTION and PARALLAX ☉, according to the *Paris*-Observatory.

Argument. Apparent Altitude ☉

Alt. ☉ °	Refract. — ′	″	Alt. ☉ °	Refract. — ′	″	Alt. ☉ °	Refract. — ′	″
0	32	20	35	1	23	70	0	21
1	27	56	36	1	20	71	0	20
2	21	4	37	1	18	72	0	19
3	16	6	38	1	15	73	0	18
4	12	48	39	1	12	74	0	17
5	10	32	40	1	10	75	0	16
6	8	55	41	1	7	76	0	14
7	7	44	42	1	5	77	0	13
8	6	47	43	1	3	78	0	12
9	6	4	44	1	1	79	0	11
10	5	28	45	0	59	80	0	10
11	4	58	46	0	58	81	0	9
12	4	32	47	0	56	82	0	8
13	4	12	48	0	54	83	0	7
14	3	54	49	0	52	84	0	6
15	3	38	50	0	50	85	0	5
16	3	24	51	0	49	86	0	4
17	3	11	52	0	47	87	0	3
18	3	0	53	0	45	88	0	2
19	2	49	54	0	43	89	0	1
20	2	39	55	0	41	90	0	0
21	2	31	56	0	40			
22	2	25	57	0	38			
23	2	18	58	0	37			
24	2	12	59	0	35			
25	2	6	60	0	34			
26	2	0	61	0	33			
27	1	55	62	0	31			
28	1	51	63	0	30			
29	1	46	64	0	28			
30	1	42	65	0	27			
31	1	38	66	0	26			
32	1	34	67	0	25			
33	1	30	68	0	24			
34	1	27	69	0	22			

Parallax ☉.

Argt. ☉ ap. Al.

Alt. °	+ ′	″
0	0	10
10	0	10
20	0	9
30	0	9
40	0	8
50	0	6
60	0	5
70	0	3
80	0	2
90	0	0

EXAMPLE.

To find the ☉ true Alt. to 7°. Alt. Apparent?

7°. Ap. Alt. — 7′. 44″. Refraction.
+ 0 10 Parallax.

Sum — 7 34 deduct.
From 7° 0 0 ☉ Ap. Alt.

☉'s true Alt. 6 52 26 required.

For

For reducing PARTS of the EQUATOR, (paſſed over by the EARTH's ROTATION, and PROGRESSION, or SUN's apparent Motion, from Noon to Noon) into Mean ſolar HOURS.

Argument. Parts of the Equator.

° / ′ / ″	H. / M. / S.	M. / S. / Th.	S. / Th. / Fo.	° / ′ / ″	H. / M. / S.	M. / S. / Th.	S. / Th. / Fo.	°	Ho.	M.	S.
1	0	3	59	31	2	3	39	70	4	39	14
2	0	7	58	32	2	7	39	80	5	19	7
3	0	11	58	33	2	11	38	90	5	59	1
4	0	15	57	34	2	15	38	100	6	38	54
5	0	19	56	35	2	19	37	110	7	18	47
6	0	23	55	36	2	23	37	120	7	58	42
7	0	27	54	37	2	27	36	130	8	38	35
8	0	31	53	38	2	31	35	140	9	18	28
9	0	35	52	39	2	35	34	150	9	58	22
10	0	39	52	40	2	39	33	160	10	38	15
11	0	43	52	41	2	43	32	170	11	18	8
12	0	47	51	42	2	47	32	180	11	58	2
13	0	51	51	43	2	51	31	190	12	37	55
14	0	55	50	44	2	55	30	200	13	17	48
15	0	59	50	45	2	59	30	210	13	57	42
16	1	3	40	46	3	3	29	220	14	37	35
17	1	7	48	47	3	7	28	230	15	17	28
18	1	11	47	48	3	11	27	240	15	57	23
19	1	15	47	49	3	15	27	250	16	37	16
20	1	19	46	50	3	19	27	260	17	17	9
21	1	23	45	51	3	23	26	270	17	57	3
22	1	27	45	52	3	27	25	280	18	36	56
23	1	31	44	53	3	31	24	290	19	16	49
24	1	35	43	54	3	35	24	300	19	56	43
25	1	39	43	55	3	39	23	310	20	36	36
26	1	43	42	56	3	43	23	320	21	16	30
27	1	47	41	57	3	47	23	330	21	56	24
28	1	51	40	58	3	51	22	340	22	36	17
29	1	55	40	59	3	55	22	350	23	16	11
30	1	59	40	60	3	59	21	360	23	56	4

EXAMPLE.

To find the mean ſolar Time anſwerable to 39°. 19′. 29″. of the Earth's Rotation?

39°. =	2h.	35m.	34s.		
19′. =		1	15	47th.	
29″. =			1	55	40fo.
	2	36	51	42	40 reqd.

For reducing *Mean ſolar* HOURS into PARTS of the EQUATOR; paſſed over, from Noon to Noon, by the EARTH's ROTATION on its AXIS and PROGRESSION in its Orbit.

Argument. Mean ſolar Hours, Minutes, Seconds, &c.. of Time.

Hours.	°	′	″	M. / S. / T.	° / ′ / ″	′ / ″ / ‴	″ / ‴ / iv	M. / S. / T.	° / ′ / ″	′ / ″ / ‴	″ / ‴ / iv
1	15	2	28	1	0	15	2	31	7	46	16
2	30	4	56	2	0	30	5	32	8	1	19
3	45	7	24	3	0	45	7	33	8	16	21
4	60	9	51	4	1	0	10	34	8	31	24
5	75	12	19	5	1	15	12	35	8	46	26
6	90	14	47	6	1	30	15	36	9	1	29
7	105	17	15	7	1	45	17	37	9	16	31
8	120	19	43	8	2	0	20	38	9	31	34
9	135	22	11	9	2	15	22	39	9	46	36
10	150	24	38	10	2	30	25	40	10	1	39
11	165	27	6	11	2	45	27	41	10	16	41
12	180	29	34	12	3	0	30	42	10	31	43
13	195	32	2	13	3	15	32	43	10	46	46
14	210	34	30	14	3	30	34	44	11	1	48
15	225	36	58	15	3	45	37	45	11	16	51
16	240	39	26	16	4	0	39	46	11	31	53
17	255	41	53	17	4	15	41	47	11	46	56
18	270	44	21	18	4	30	44	48	12	1	58
19	285	46	49	19	4	45	47	49	12	17	1
20	300	49	17	20	5	0	49	50	12	32	3
21	315	51	45	21	5	15	52	51	12	47	6
22	330	54	13	22	5	30	54	52	13	2	8
23	345	56	40	23	5	45	57	53	13	17	11
24	360*	59	8	24	6	0	59	54	13	32	13
				25	6	16	2	55	13	47	16
				26	6	31	4	56	14	2	18
				27	6	46	7	57	14	17	21
				28	7	1	9	58	14	32	23
				29	7	16	11	59	14	47	26
				30	7	31	14	60	15	2	28

**360° or 1 Revol. of the ⊖'s Equatr is theref. performed in 23h 56m 4s 7th mean ſolar Time.*

EXAMPLE.

To find the Deg. of the Earth's Rotation anſwerable to 23h 56m 4s 7th of mean ſolar Time?

23h =	345°	56′	40″		
56m =	14	2	18		
4s =		1	0	10‴	
7th =			1	45	17iv
	359	59	59	55	17

A Revolution nearly of the Earth's Equator, reqd.

The DIFFERENCE of Mean *ſolar* above *ſyderial* HOURS.

Argument. Mean Hours, Minutes, Secs, of Time.

H. / M. / S.	M. / S. / T.	S. / T. / F.	T. / F. / Fi.	H / M / S.	M. / S. / T.	S. / T. / F.	T. / F. / Fi.
1	0	9	51	31	5	5	33
2	0	19	43	32	5	15	24
3	0	29	34	33	5	25	15
4	0	39	25	34	5	35	7
5	0	49	17	35	5	44	58
6	0	59	8	36	5	54	50
7	1	9	0	37	6	4	41
8	1	18	51	38	6	14	32
9	1	28	42	39	6	24	24
10	1	38	34	40	6	34	15
11	1	48	25	41	6	44	6
12	1	58	17	42	6	53	58
13	2	8	8	43	7	3	49
14	2	17	59	44	7	13	41
15	2	27	51	45	7	23	32
16	2	37	42	46	7	33	23
17	2	47	33	47	7	43	15
18	2	57	25	48	7	33	6
19	3	7	16	49	8	2	58
20	3	17	8	50	8	12	49
21	3	26	59	51	8	22	40
22	3	36	50	52	8	32	32
23	3	46	42	53	8	42	23
24	3	56	33	54	8	52	14
25	4	6	24	55	9	2	6
26	4	16	16	56	9	11	57
27	4	26	7	57	9	21	49
28	4	35	59	58	9	31	40
29	4	45	50	59	9	41	31
30	4	55	41	60	9	51	23

CONSTRUCTION.

To find the Exceſs of 24 mean ſolar Hours, above 24 ſyderial Hours?

24h mean = 360°. 59′, 8″. 10‴. by Earth's Rotation.
But, 59′. = 3m. 56s.
See 8″ + 10‴ = 0 33th
p. 28.
Exceſs 3 56 33
as by Tab. M. Time required.

N. B. A *ſyderial* Day is the Time in which a *Fixed Star,* or the ſame Point of the *Equinoctial* returns to the *ſame Meridian*; making a Revolution, or 360°, of the *Earth's Equator.*

A mean *ſolar Day* is the Time in which the SUN returns to the ſame Meridian; making 360°. 59′. 8″. 10‴. of the *Earth's Equator,* at a mean Rate of the Earth's Progreſſion and Rotation: By which Means the SUN apparently retards of the *Fixed Stars,* or *Fixed Stars* accelerate of the SUN, at the mean Rate of 59′. 8″. 10‴, or 3m. 56s. 33th. of Time, each Day.

A TABLE,

not P 168

10 add to 6 Col gives the ... for the ...

10 add to Col 3 gives the ... Style

A TABLE, shewing the DIFFERENCE between the *Julian*, *Gregorian*, and *Solar* YEARS, from 1600.

Add 10 Days to the Days in the 3[d] and 9[th] Col[s], and the Sum will be the Days the *Gregorian* is forward of the *Julian* Account, or D[s] Dif. betw. N. and Old Style.

Years of *Christ*.	*Solar* Years from 1600. *Gregorian* Years from 1600. *Jul.* Y[rs] from 1600. Centuries.	Days add to *Jul.* Y[rs] for *Greg.*	Hours sub. fr. or add to Gregor[n] for Solar Years.	The *Lun. Cycle* of 19 Years goes back in the Jul. *Account*. D[s] & P[ts] sub. fr. 3 Col.	*Whole* D[s] Dif. bet. 3[d] & 5[th] Col[s], the *Lun. Cycle* goes forward in the *Greg.* Account
N°Col[s] 1.	2.	3.	4.	5.	6.
1600		0			
1700	1	1	− 6	$\frac{1}{3}$	1
1800	2	2	− 11	$\frac{2}{3}$	1
1900	3	3	− 17	1	2
2000	4	3	+ 2	$1\frac{1}{3}$	2
2100	5	4	− 4	$1\frac{2}{3}$	2
2200	6	5	− 2	2	3
2300	7	6	− 14	$2\frac{1}{3}$	4
2400	8	6	+ 4	$2\frac{2}{3}$	3
2500	9	7	− 2	3	4
2600	10	8	− 7	$3\frac{1}{3}$	5
2700	11	9	− 13	$3\frac{2}{3}$	5
2800	12	9	+ 6	4	5
2900	13	10	+ 0	$4\frac{1}{3}$	6
3000	14	11	− 5	$4\frac{2}{3}$	6
3100	15	12	− 10	5	7
3200	16	12	+ 8	$5\frac{1}{4}$	7
3300	17	13	+ 2	$5\frac{1}{2}$	7
3400	18	14	− 4	$5\frac{3}{4}$	8
3500	19	15	− 9	6	9
3600	20	15	+ 9	$6\frac{1}{3}$	8* 9
3700	21	16	+ 4	$6\frac{2}{3}$	9
3800	22	17	− 2	7	10
3900	23	18	− 8	$7\frac{1}{3}$	10* 11
4000	24	18	+ 11	$7\frac{2}{3}$	10
4100	25	19	+ 6	8	11
4200	26	20	+ 0	$8\frac{1}{3}$	12
4300	27	21	− 5	$8\frac{2}{3}$	12
4400	28	21	+ 13	9	12
4500	29	22	+ 7	$9\frac{1}{3}$	13
4600	30	23	+ 2	$9\frac{2}{3}$	13
4700	31	24	− 4	10	14
4800	32	24	+ 15	$10\frac{1}{3}$	14
4900	33	25	+ 9	$10\frac{2}{3}$	14
5000	34	26	+ 4	11	15
5100	35	27	− 2	$11\frac{1}{3}$	16
5200	36	27	+ 17	$11\frac{2}{3}$	15

Years of *Christ*.	*Solar* Years from 1600. *Gregorian* Y[rs]. from 1600. *J.* Y[rs] from 1600. Cen[s].	Days add to *Jul.* Y[rs]. for *Greg.*	Hours add to *Gregor.* for *Solar* Years.	The *Lun. Cycle* of 19 Y[rs] goes back in the *Jul. Account*. D[s] & P[ts] sub. fr. 9 Col.	*Whole* D[s] Dif. bet. 9[th] and 11[th] Col[s] The *Lun. Cycle* goes forward in the *Greg.* Account
7.	8.	9.	10.	11.	12.
5300	37	28	+ 11	12	16
5400	38	29	6	$12\frac{1}{4}$	17
5500	39	30	0	$12\frac{2}{3}$	17
5600	40	30	19	13	17
5700	41	31	13	$13\frac{1}{3}$	18
5800	42	32	7	$13\frac{2}{3}$	18
5900	43	33	2	14	19
6000	44	33	21	$14\frac{1}{4}$	19
6100	45	34	15	$14\frac{1}{2}$	19
6200	46	35	9	$14\frac{3}{4}$	20
6300	47	36	4	15	21
6400	48	36	22	$15\frac{1}{3}$	20* 21
6500	49	37	7	$15\frac{2}{3}$	21
6600	50	38	11	16	22
6700	51	39	6	$16\frac{1}{3}$	23
6800	52	39	24	$16\frac{2}{3}$	22
6900	53	40	19	17	23
7000	54	41	13	$17\frac{1}{3}$	24
7100	55	42	7	$17\frac{2}{3}$	24
7200	56	42	26	18	24
7300	57	43	21	$18\frac{1}{3}$	25
7400	58	44	15	$18\frac{2}{3}$	25
7500	59	45	10	19	26
7600	60	45	28	$19\frac{1}{3}$	26
7700	61	46	23	$19\frac{2}{3}$	26
7800	62	47	17	20	27
7900	63	48	12	$20\frac{1}{3}$	28
8000	64	48	30	$20\frac{2}{3}$	27
8100	65	49	24	21	28
8200	66	50	19	$21\frac{1}{3}$	29
8300	67	51	13	$21\frac{2}{3}$	29
8400	68	51	32	22	29
8500	69	52	26	$22\frac{1}{3}$	30
8600	70	53	21	$22\frac{2}{3}$	0
&c.	&c.	&c.	&c.	&c.	&c.

EXAMPLE of the USE. *In* 10 *Hundred* Julian *Years there are* 10 *Hundred Years* Gregorian *and* 8 *Days*; *and* 10 *Hundred* Solar *Years*, 8 *Days* — 7 *Hours: so that the* Gregorian *Account will, in that Period, be* 8 *Days forward of the Month Days of the* Julian *Reckoning. And the Seasons of the* Solar *Years, in that Time, will be* 7 *Hours backward of the* Gregorian *Account. Also the* Solar *Seasons, or Years, will be* 8 *Days* — 7 *Hours forward of the Month-Days in the* Julian *Reckoning.*

POPE

CONSTRUCTION of the FOREGOING TABLE.

POPE *GREGORY* XIII, in the Beginning of the Month of *October* 1582, adjusted the *Julian* to the *Solar* Account of Time, from which *Period* the foregoing *Table* is composed; shewing, at Sight, the *Difference*, in Days, betwixt the *Julian*, *Gregorian*, and *Solar* Years. Wherein you may see how many Days the *Gregorian* Years, in given Centuries, advance (with Respect to Month-days) of the same Number of Years *Julian*. And how many Hours the *Solar* Years or *Seasons*, go forward or retreat, (with Respect to the Month-days) in the same Number of Centuries of *Gregorian* Years. As also the Number of Days and Hours the *Solar* Seasons, or Years, retreat (with Respect to Month-days) in the *Julian* Account. And the Number of Days the *Lunar Cycle* (of 19 Years) falls back in the Months of the *Julian* Reckoning in a given Period. By comparing which Retardation of the Lunar Cycle, in the Month days of the *Julian* Account, with the Month-days advanced by the *Gregorian* of the *Julian Reckoning*, in the same Period (referring to one Standard), the *Difference*, or Excess, will be the Days that the *Lunar* Cycle is carried forward in the Month-days, (in the same Period) of the *Gregorian* Account.

Hence, the Reason of the *Golden Numbers* being carried forward by certain Days, in certain Periods, in the Earl of *Macclesfield*'s *curious Table* for finding *Easter* Full Moon; and hence the Mystery of the two last Tables in the *Style-Act* is unfolded.

Note, A Solar Year is here stated at $365^d\ 5^h\ 48^m\ 55^s$, wanting $11^m\ 5^s$ of a *Julian* Year; by which the odd Hours in the 4th and 10th *Columns* are computed. The *Julian* Anticipation of the *Lunar* Cycle of 19 Years is according to that of a Day in 310,7 *Julian* Years; whence the 5^{th} and 11^{th} Columns are computed near the Truth. Wherein *above half* a Day is taken for another *whole Day*; but less than half a Day more is taken for Nothing more. Our Table corrects, in some Periods, by a *whole Day*, the *Style-Act Table*. } query

There being 146097 *Days in* 400 *Gregorian Years, or* 3 *Days less than in the same Number of Years Julian.*

Greg Year 365.5.49.12

	d	h	m	s	th		
In 19 *Gregorian Years there will be*	6939	14	34	48	0	=	6939^d,6075
But in 235 *Synodical Months there are*	6939	16	31	56	30	=	6939 ,688848
Hence the New *or* Full *Moon goes forward in one Lunar* Cycle, *the Difference*		1	57	8	30	=	,081348

Whence, in about 233,56 *Years Gregorian, if the Gregorian Year went regularly forward of the Julian, as to the Month-day of each Account, a* New *or* Full *Moon would be advanced* one Month-day, *by the* Lunar *Cycle, in the Gregorian Account. But* 12 *Days completely are advanced in* 2800 *Gregorian Years. And our Table shews that the Number of Days* 3, 6, 9, 12, *&c. should stand against* 2200, 2900, 3700, 4400, *&c. as they stand in the* Style-Act Table. *And that* 9 and not 8 *should stand against* 3600, 11 and not 10 *against* 3900, *and* 21 and not 20, *against* 6400, correcting the Errors in the Style Act Table.

EXAMPLE. *To find the Anticipation of the* Lunar Cycle *in the* Julian *Account, for any Number of Years* Julian; *suppose* 2300 *from the Year* 1600, *N. S.?*

As 310,7 Years : 1 Day :: 100 Years : ,322 Day, nearly; a *constant Multiplier* for Hundreds. Whence 23 × ,322 = 7,4 Days, or 7 nearest, *required*.

The *Gregorian* Month-days being then advanced 18 Days forward of the *Julian* Month-days, therefore 18—7 = 11 Days, the *Lunar Cycle* is then advanced in the Month-days of the *Gregorian* Account, *and not* 10, *as in the Style-Act Table.*

To find the Julian, Gregorian, *and* Solar Years, *or the different Accounts of Time, correspondent to each other?*

EXAMPLE. 1400 Jul. Y^{rs} = 1400 Greg. Y^{rs} + 11 Days, the *Gregorian* Account of Time.
1400 Gr. Y^{rs} + 1400 × $11^m\ 5^s$ = 1400 ——— + $10^d\ 18^h\ 36^m\ 40^s$, the *Solar* Account.

N. B. The Julian is then short of the Gregorian Account by 11 Days. } Diff. — 5 23 20 (as by *Table*) the *Solar* Account is short of the *Gregorian*.

By the above *Rule* the 4th and 10th Columns are constructed.

DECIMALS of a DAY.

N. B. A Figure *with a fine Stroke cross it, denotes that the following Decimals repeat from thence* ad infinitum. *And a* Dot (.) *after any Figure, denotes that Decimal to be correct.*

Hours.		Minutes.				Seconds.			
Ho.	Decim.	Min.	Decim.	Min.	Decim.	Sec.	Decim.	Sec.	Decim.
1	0,04166	1	,000694	31	,021527	1	,0000115740	31	,0003587962
2	0,08333	2	,001388	32	,022222	2	,000023448	32	,000370370
3	0,125.	3	,002083	33	,022916	3	,0000347222	33	,000381944
4	0,16666	4	,002777	34	,023611	4	,000046296	34	,000393518
5	0,20833	5	,003472	35	,024305	5	,0000578703	35	,0004050925
6	0,25.	6	,004166	36	,025.	6	,0000694444	36	,000416666
7	0,29166	7	,004861	37	,025694	7	,0000810185	37	,0004282407
8	0,33333	8	,005555	38	,026388	8	,000092592	38	,000439814
9	0,375.	9	,00625.	39	,027083	9	,000104166	39	,000451388
10	0,41666	10	,006944	40	,027777	10	,000115740	40	,000462962
11	0,45833	11	,007638	41	,028472	11	,0001273148	41	,0004745370
12	0,5.	12	,008333	42	,029166	12	,000138888	42	,000486111
13	0,54166	13	,009027	43	,029861	13	,0001504629	43	,0004976851
14	0,58333	14	,009722	44	,030555	14	,000162037	44	,000509259.
15	0,625.	15	,010416	45	,03125.	15	,000173611	45	,000520833
16	0,66666	16	,011111	46	,031944	16	,000185185	46	,0005324074
17	0,70833	17	,011805	47	,032638	17	,0001967592	47	,0005439814
18	0,75.	18	,0125.	48	,033333	18	,000208333	48	,000555555
19	0,79166	19	,013194	49	,034027	19	,0002199074	49	,0005671296
20	0,83333	20	,013888	50	,034722	20	,00023148	50	,000578704.
21	0,875.	21	,014583	51	,035416	21	,000243055	51	,000590277
22	0,91666	22	,015277	52	,036111	22	,000254629	52	,0006018518
23	0,95833	23	,015972	53	,036805	23	,0002662037	53	,0006134259
24	1,	24	,016666	54	,0375.	24	,000277777	54	,000625.
25	1,04166	25	,017361	55	,038194	25	,0002893518	55	,0006365740
26	1,08333	26	,018055	56	,038888	26	,000300925	56	,000648148
27	1,125.	27	,01875.	57	,039583	27	,0003125.	57	,000659722
28	1,16666	28	,019444	58	,040277	28	,000324074	58	,000671296
29	1,20833	29	,020138	59	,040972	29	,0003356481	59	,0006828703
30	1,25.	30	,020833	60	,041666	30	,000347222	60	,000694444

A TABLE of the NUMBER of DAYS from any one Day in any MONTH, to the same Day in any other MONTH following.

Months.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	273	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
August	153	184	212	243	273	304	334	365	31	61	92	122
September	122	153	181	212	242	273	303	334	365	30	61	91
October	92	123	151	182	212	243	273	304	335	365	31	61
November	61	92	120	151	181	212	242	273	304	334	365	30
December	31	62	90	121	151	182	212	243	274	304	335	365

N. B. One Day must be added when *February* of Leap-year comes between two Months.

EXAMPLE. *To find the Number of Days betwixt* December 19, 1759, *and* July 24, *following?*

From *December* 19 to *July* 19 following, we find, to the Right, against *Dec.* and under *July*, 213 Days, (adding 1 for *Feb.* of Leap-year coming between) to which 5 Days more being added, (from 19 to 24th *July*) the Sum is 218 Days *required.*

MEAN

MEAN MOTION of the SUN for MONTHS and DAYS, to Thirds of a DEGREE, for correctly constructing TABLES, pag. 5, 6, 7.

D^s.	Months	M. Motion ☉. s	°	′	″	‴	Apog. ″	‴	Stars. ″	‴
	Jan. 0	0	0	0	0	0	0	0	0	0
31	*Feb.* 0	1	0	33	18	13	5	13	4	17
59	*March* 0	1	28	9	11	26	9	56	8	9
90	*April* 0	2	28	42	29	38	15	9	12	26
120	*May* 0	3	28	16	39	30	20	12	16	35
151	*June* 0	4	28	49	57	42	25	25	20	52
181	*July* 0	5	28	24	7	44	30	28	25	1
212	*August* 0	6	28	57	25	56	35	42	29	19
243	*Sept.* 0	7	29	30	44	8	40	55	33	36
273	*Oct.* 0	8	29	4	54	0	45	58	37	44
304	*Nov.* 0	9	29	38	12	12	51	11	42	2
334	*Dec.* 0	10	29	12	22	4	56	14	46	10
	Days 1	0	0	59	8	20	0	10	0	8
	2	0	1	58	16	39	0	20	0	16
	3	0	2	57	24	59	0	30	0	25
	4	0	3	56	33	19	0	40	0	33
	5	0	4	55	41	39	0	50	0	41
	6	0	5	54	49	58	1	0	0	49
	7	0	6	53	58	18	1	11	0	58
	8	0	7	53	6	38	1	21	1	6
	9	0	8	52	14	58	1	31	1	14
	10	0	9	51	23	17	1	41	1	23
	11	0	10	50	31	37	1	51	1	31
	12	0	11	49	39	57	2	1	1	39
	13	0	12	48	48	17	2	11	1	47
	14	0	13	47	56	36	2	21	1	56
	15	0	14	47	4	56	2	31	2	4
	16	0	15	46	13	16	2	42	2	13
	17	0	16	45	21	36	2	52	2	21
	18	0	17	44	29	55	3	2	2	29
	19	0	18	43	38	15	3	12	2	37
	20	0	19	42	46	35	3	22	2	46
	21	0	20	41	54	55	3	32	2	54
	22	0	21	41	3	14	3	42	3	2
	23	0	22	40	11	34	3	52	3	11
	24	0	23	39	19	54	4	2	3	19
	25	0	24	38	28	14	4	12	3	27
	26	0	25	37	36	33	4	23	3	35
	27	0	26	36	44	53	4	33	3	44
	28	0	27	35	53	13	4	43	3	52
	29	0	28	35	1	33	4	53	4	0
	30	0	29	34	9	52	5	3	4	9
	31	1	0	33	18	12	5	13	4	17

Correct CONSTRUCTION of *Tab.* p. 5, 6, 7.

May	3	28	16	39	30	20	12	16	35
30	0	29	34	9	52	5	3	4	9
May 30	4	27	50	49	22	25	15	20	44
October	8	29	4	54	0	45	58	37	44
19	0	18	43	38	15	3	12	2	37
October 19 &c.	9	17	48	32	15	49	10	40	21

EQUATION of the POINTS of the EQUINOCTIAL, for the computed *Longitudes* of the SUN and MOON, from the Mean *Ecliptic* OBLIQUITY, 23° 28′ 30″. Also the EQUAT. of the *M.* to the *tr. Ecliptic* OBLIQUITY. Together with the *Annual Precess.* of the Equ^x. from the NUTATION of the Earth's *Axis*, during one Revol. of the ☽'s ☊, accor^g to Dr. BRADLEY's Improv^ts. of the *R. Observ.* at *Greenwich*.

Arg. LONGITUDE of the MOON's Node, from the *Equinox*.

Lon. ☽'s ☊ s °	Equ. to Points of Eq^x. ″	Eq^n. to M.Obl^y of Ecl^c. ″	True Obliquity of the Ecliptic. ° ′ ″	Eq^n to M.Obl^y of Ecl^c. ″	Annual Prec. of Eq. P^ts. ″	Eq^n. to Points of Eq^x. ″	Long. ☽'s ☊ s °
0 0	—0,	+9,0	23 28 39,	+9,0	58,0	+0,	12 0
5	—2,	+9,0	39,	+9,0	57,9	+2,	25
10	—3,9	+8,9	38,9	+8,9	57,9	+3,9	20
15	—5,8	+8,7	38,7	+8,7	57,7	+5,8	15
20	—7,7	+8,5	38,5	+8,5	57,5	+7,7	10
25	—9,6	+8,2	38,2	+8,2	57,3	+9,6	5
1 0	—11,3	+7,8	23 28 37,8	+7,8	57,0	+11,3	11 0
5	—13,	+7,4	37,4	+7,4	56,6	+13,	25
10	—14,5	+6,9	36,9	+6,9	56,2	+14,5	20
15	—16,	+6,4	36,4	+6,4	55,7	+16,	15
20	—17,3	+5,8	35,8	+5,8	55,2	+17,3	10
25	—18,5	+5,2	35,2	+5,2	54,7	+18,5	5
2 0	—19,6	+4,5	23 28 34,5	+4,5	54,2	+19,6	10 0
5	—20,5	+3,8	33,8	+3,8	53,6	+20,5	25
10	—21,2	+3,1	33,1	+3,1	53,0	+21,2	20
15	—21,8	+2,3	32,3	+2,3	52,3	+21,8	15
20	—22,2	+1,6	31,6	+1,6	51,7	+22,2	10
25	—22,5	+0,8	30,8	+0,8	51,0	+22,5	5
3 0	—22,6	+0,0	23 28 30,	+0,0	50,3	+22,6	9 0
5	—22,5	—0,8	29,2	—0,8	49,7	+22,5	25
10	—22,2	—1,6	28,4	—1,6	49,0	+22,2	20
15	—21,8	—2,3	27,7	—2,3	48,4	+21,8	15
20	—21,2	—3,1	26,9	—3,1	47,7	+21,2	10
25	—20,5	—3,8	26,2	—3,8	47,1	+20,5	5
4 0	—19,6	—4,5	23 28 25,5	—4,5	46,5	+19,6	8 0
5	—18,5	—5,2	24,8	—5,2	46,0	+18,5	25
10	—17,3	—5,8	24,2	—5,8	45,5	+17,3	20
15	—16,	—6,4	23,6	—6,4	45,0	+16,	15
20	—14,5	—6,9	23,1	—6,9	44,5	+14,5	10
25	—13,	—7,4	22,6	—7,4	44,1	+13,	5
5 0	—11,3	—7,8	23 28 22,2	—7,8	43,7	+11,3	7 0
5	—9,6	—8,2	21,8	—8,2	43,4	+9,6	25
10	—7,7	—8,5	21,5	—8,5	43,2	+7,7	20
15	—5,8	—8,7	21,3	—8,7	43,0	+5,8	15
20	—3,9	—8,9	21,1	—8,9	42,8	+3,9	10
25	—2,	—9,	21,	—9,	42,8	+2,	5
6 0	—0,	—9,	23 28 21,	—9,	42,7	+0,	6 0
Lon. ☽'s ☊	Eq^n. to Points of Eq^x.	Eq^n. to M.Obl. of Ecl^c.	True Obliquity of the Ecliptic.	Eq^n to M.Obl^y of Ecl^c	Annual Prec. of Eq. P^ts.	Eq^n. to Points of Eq^x.	Long. ☽'s ☊

Ex. The *Long.* ☽'s ☊ *being* 4^s 10° 41′ 10″, *The Sun and Moon's computed Longitudes* (from the mean Ecliptic Obliquity) 10^s 23° 34′ 46″, and 0^s 20° 27′ 20″, *respectively, to find the* ☉ *and* ☽'s *correct Places for the true ecliptic Obliquity ?*

☉ comp. Pl. ☽ comp. Pl.

10^s 23° 34′ 46″ : . 0^s 20° 27′ 20″

By the Argument, Equation —17 . . Equation —17

Correct Place ☉ 10 23 34 29 . ☽ . 0 20 27 3 *required.*

True *Ecliptic Obliquity* . . . 23° 28′ 24″ } *about the same Position of the*
Annual Precession of the *Equinox* . . . 49 } ☽'s ☊.

Radical

Radical Mean PLACES of the MOON, from 1652 to 1752, Old STYLE.

Julian Style.	M. Pla. ☽. s	°	′	″	M. Pl. Ap. ☽. s	°	′	″	M. Pl. ☊. s	°	′	″
B. 1652	9	27	24	19	4	24	24	34	0	15	8	49
53	2	6	47	22	6	5	4	24	11	25	49	6
54	6	16	10	26	7	15	44	15	11	6	29	23
55	10	25	33	30	8	26	24	6	10	17	9	39
B. 1656	3	18	7	8	10	7	10	37	9	27	46	46
57	7	27	30	11	11	17	50	27	9	8	27	3
58	0	6	53	15	0	28	30	18	8	19	7	20
59	4	16	16	19	2	9	10	9	7	29	47	36
B. 1660	9	8	49	57	3	19	56	40	7	10	24	43
61	1	18	13	0	5	0	36	30	6	21	5	0
62	5	27	36	4	6	11	16	21	6	1	45	17
63	10	6	59	8	7	21	56	12	5	12	25	33
B. 1664	2	29	32	46	9	2	42	43	4	23	2	40
65	7	8	55	49	10	13	22	33	4	3	42	57
66	11	18	18	53	11	24	2	24	3	14	23	14
67	3	27	41	57	1	4	42	15	2	25	3	30
B. 1668	8	20	15	35	2	15	28	46	2	5	40	37
69	0	29	38	38	3	26	8	36	1	16	20	54
70	5	9	1	42	5	6	48	27	0	27	1	11
71	9	18	24	46	6	17	28	18	0	7	41	27
B. 1672	2	10	58	24	7	28	14	49	11	18	18	34
73	6	20	21	27	9	8	54	39	10	28	58	51
74	10	29	44	31	10	19	34	30	10	9	39	8
75	3	9	7	35	0	0	14	21	9	20	19	24
B. 1070	8	1	41	13	1	11	0	52	9	0	56	31
77	0	11	4	16	2	21	40	42	8	11	36	48
78	4	20	27	20	4	2	20	33	7	22	17	5
79	8	29	50	24	5	13	0	24	7	2	57	21
B. 1680	1	22	24	2	6	23	46	55	6	13	34	28
81	6	1	47	5	8	4	26	45	5	24	14	45
82	10	11	10	9	9	15	6	36	5	4	55	2
83	2	20	33	13	10	25	46	27	4	15	35	18
B. 1684	7	13	6	51	0	6	32	58	3	26	12	25
85	11	22	29	54	1	17	12	48	3	6	52	42
86	4	1	52	58	2	27	52	39	2	17	32	59
87	8	11	16	2	4	8	32	30	1	28	13	15
B. 1688	1	3	49	40	5	19	19	1	1	8	50	22
89	5	13	12	43	6	29	58	51	0	19	30	39
90	9	22	35	47	8	10	38	42	0	0	10	56
91	2	1	58	51	9	21	18	33	11	10	51	12
B. 1692	6	24	32	29	11	2	5	4	10	21	28	19
93	11	3	55	32	0	12	44	54	10	2	8	36
94	3	13	18	36	1	23	24	45	9	12	48	53
95	7	22	41	40	3	4	4	36	8	23	29	9
B. 1696	0	15	15	18	4	14	51	7	8	4	6	16
97	4	24	38	21	5	25	30	57	7	14	46	33
98	9	4	1	25	7	6	10	48	6	25	26	50
99	1	13	24	29	8	16	50	39	6	6	7	6

LUNAR TABLES.

Julian Style.	M. Pla. ☽. s	°	′	″	M. Pl. Ap. ☽. s	°	′	″	M. Pl. ☊. s	°	′	″
B. 1700	6	5	58	7	9	27	37	10	5	16	44	13
1	10	15	21	10	11	8	17	0	4	27	24	30
2	2	24	44	14	0	18	56	51	4	8	4	47
3	7	4	7	18	1	29	36	42	3	18	45	3
B. 1704	11	26	40	56	3	10	23	13	2	29	22	10
5	4	6	3	59	4	21	3	3	2	10	2	27
6	8	15	27	3	6	1	42	54	1	20	42	44
7	0	24	50	7	7	12	22	45	1	1	23	0
B. 1708	5	17	23	45	8	23	9	16	0	12	0	7
9	9	26	46	48	10	3	49	6	11	22	40	24
10	2	6	9	52	11	14	28	57	11	3	20	41
11	6	15	32	56	0	25	8	48	10	14	0	57
B. 1712	11	8	6	34	2	5	55	19	9	24	38	4
13	3	17	29	37	3	16	35	9	9	5	18	21
14	7	26	52	41	4	27	15	0	8	15	58	38
15	0	6	15	45	6	7	54	51	7	26	38	54
B. 1716	4	28	49	23	7	18	41	22	7	7	16	1
17	9	8	12	26	8	29	21	12	6	17	56	18
18	1	17	35	30	10	10	1	3	5	28	36	35
19	5	26	58	34	11	20	40	54	5	9	16	51
B. 1720	10	19	32	12	1	1	27	25	4	19	53	58
21	2	28	55	15	2	12	7	15	4	0	34	15
22	7	8	18	19	3	22	47	6	3	11	14	32
23	11	17	41	23	5	3	26	57	2	21	54	48
B. 1724	4	10	15	1	6	14	13	28	2	2	31	55
25	8	19	38	4	7	24	53	18	1	13	12	12
26	0	29	1	8	9	5	33	9	0	23	52	29
27	5	8	24	12	10	16	13	0	0	4	32	45
B. 1728	10	0	57	50	11	26	59	31	11	15	9	52
29	2	10	20	53	1	7	39	21	10	25	50	9
30	6	19	43	57	2	18	19	12	10	6	30	26
31	10	29	7	1	3	28	59	3	9	17	10	42
B. 1732	3	21	40	39	5	9	45	34	8	27	47	49
33	8	1	3	42	6	20	25	24	8	8	28	6
34	0	10	26	46	8	1	5	15	7	19	8	23
35	4	19	49	50	9	11	45	6	6	29	48	39
B. 1736	9	12	23	28	10	22	31	37	6	10	25	46
37	1	21	46	31	0	3	11	27	5	21	6	3
38	6	1	9	35	1	13	51	18	5	1	46	20
39	10	10	32	39	2	24	31	9	4	12	26	36
B. 1740	3	3	6	17	4	5	17	40	3	23	3	43
41	7	12	29	20	5	15	57	30	3	3	44	0
42	11	21	52	24	6	26	37	21	2	14	24	17
43	4	1	15	28	8	7	17	12	1	25	4	33
B. 1744	8	23	49	6	9	18	3	43	1	5	41	40
45	1	3	12	9	10	28	43	33	0	16	21	57
46	5	12	35	13	0	9	23	24	11	27	2	14
47	9	21	58	17	1	20	3	15	11	7	42	30
B. 1748	2	14	31	55	3	0	49	46	10	18	19	37
49	6	23	54	58	4	11	29	36	9	28	59	54
50	11	3	18	2	5	22	9	27	9	9	40	11
51	3	12	41	6	7	2	49	18	8	20	20	27
B. 1752	8	5	14	44	8	13	35	49	8	0	57	34

Radical

Radical Mean PLACES of the MOON, from 1752 to 1852, *New* STYLE.

Gregorian Style.	M. Pla. ☽.				M. Pl. Ap. ☽.				M. Pla. ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
B. 1752	3	10	18	19	8	12	22	17	8	1	32	31
53	7	19	41	22	9	23	2	7	7	12	12	48
54	11	29	4	26	11	3	41	58	6	22	53	5
55	4	8	27	30	0	14	21	49	6	3	33	21
B. 1756	9	1	1	8	1	25	8	20	5	14	10	28
57	1	10	24	11	3	5	48	10	4	24	50	45
58	5	19	47	15	4	16	28	1	4	5	31	2
59	9	29	10	19	5	27	7	52	3	16	11	18
B. 1760	2	21	43	57	7	7	54	23	2	26	48	25
61	7	1	7	0	8	18	34	13	2	7	28	42
62	11	10	30	4	9	29	14	4	1	18	8	59
63	3	19	53	8	11	9	53	55	0	28	49	15
B. 1764	8	12	26	46	0	20	40	26	0	9	26	22
65	0	21	49	49	2	1	20	16	11	20	6	39
66	5	1	12	53	3	12	0	7	11	0	46	56
67	9	10	35	57	4	22	39	58	10	11	27	12
B. 1768	2	3	9	35	6	3	26	29	9	22	4	19
69	6	12	32	38	7	14	6	19	9	2	44	36
70	10	21	55	42	8	24	46	10	5	13	24	53
71	3	1	18	46	10	5	26	1	7	24	5	9
B. 1772	7	23	52	24	11	16	12	32	7	4	42	16
73	0	3	15	27	0	26	52	22	6	15	22	33
74	4	12	38	31	2	7	32	13	5	26	2	50
75	8	22	1	35	3	18	12	4	5	6	43	6
B. 1776	1	14	35	13	4	28	58	35	4	17	20	13
77	5	23	58	16	6	9	38	25	3	28	0	30
78	10	3	21	20	7	20	18	16	3	8	40	47
79	2	12	44	24	9	0	58	7	2	19	21	3
B. 1780	7	5	18	2	10	11	44	38	1	29	58	10
81	11	14	41	5	11	22	24	28	1	10	38	27
82	3	24	4	9	1	3	4	19	0	21	18	44
83	8	3	27	13	2	13	44	10	0	1	59	0
B. 1784	0	26	0	51	3	24	30	41	11	12	36	7
85	5	5	23	54	5	5	10	31	10	23	16	24
86	9	14	46	58	6	15	50	22	10	3	56	41
87	1	24	10	2	7	26	30	13	9	14	36	57
B. 1788	6	16	43	40	9	7	16	44	8	25	14	4
89	10	26	6	43	10	17	56	34	8	5	54	21
90	3	5	29	47	11	28	36	25	7	16	34	38
91	7	14	52	51	1	9	16	16	6	27	14	54
B. 1792	0	7	26	29	2	20	2	47	6	7	52	1
93	4	16	49	32	4	0	42	37	5	18	32	18
94	8	26	12	36	5	11	22	28	4	29	12	35
95	1	5	35	40	6	22	2	19	4	9	52	51
B. 1796	5	28	9	18	8	2	48	50	3	20	29	58
97	10	7	32	21	9	13	28	40	3	1	10	15
98	2	16	55	25	10	24	8	31	2	11	50	32
99	6	26	18	29	0	4	48	22	1	22	30	48

For Advantage of taking out the Numbers after January *and* February, Bissextile Years *Places are advanced a Day's Motion, in both Styles, correspondent to the mean Noon of* January *the 1st.*

Gregorian Style.	M. Pla. ☽.				M. Pl. Ap. ☽.				M. Pla. ☊.			
	s	°	′	″	s	°	′	″	s	°	′	″
1800	11	5	41	32	1	15	28	12	1	3	11	5
1	3	15	4	35	2	26	8	2	0	13	51	22
2	7	24	27	39	4	6	47	53	11	24	31	39
3	0	3	50	43	5	17	27	44	11	5	11	55
B. 1804	4	26	24	21	6	28	14	15	10	15	49	2
5	9	5	47	24	8	8	54	5	9	26	29	19
6	1	15	10	28	9	19	33	56	9	7	9	36
7	5	24	33	32	11	0	13	47	8	17	49	52
B. 1808	10	17	7	10	0	11	0	18	7	28	26	59
9	2	26	30	13	1	21	40	8	7	9	7	16
10	7	5	53	17	3	2	19	59	6	19	47	33
11	11	15	16	21	4	12	59	50	6	0	27	49
B. 1812	4	7	49	59	5	23	46	21	5	11	4	56
13	8	17	13	2	7	4	26	11	4	21	45	13
14	0	26	36	6	8	15	6	2	4	2	25	30
15	5	5	59	10	9	25	45	53	3	13	5	46
B. 1816	9	28	32	48	11	6	32	24	2	23	42	53
17	2	7	55	51	0	17	12	14	2	4	23	10
18	6	17	18	55	1	27	52	5	1	15	3	27
19	10	26	41	59	3	8	31	56	0	25	43	43
B. 1820	3	19	15	37	4	19	18	27	0	6	20	50
21	7	28	38	40	5	29	58	17	11	17	1	7
22	0	8	1	44	7	10	38	8	10	27	41	24
23	4	17	24	48	8	21	17	59	10	8	21	40
B. 1824	9	9	58	26	10	2	4	30	9	18	58	47
25	1	19	21	29	11	12	44	20	8	29	39	4
26	5	28	44	33	0	23	24	11	8	10	19	21
27	10	8	7	37	2	4	4	2	7	20	59	37
B. 1828	3	0	41	15	3	14	50	33	7	1	36	44
29	7	10	4	18	4	25	30	23	6	12	17	1
30	11	19	27	22	6	6	10	14	5	22	57	18
31	3	28	50	26	7	16	50	5	5	3	37	34
B. 1832	8	21	24	4	8	27	36	36	4	14	14	41
33	1	0	47	7	10	8	16	26	3	24	54	58
34	5	10	10	11	11	18	56	17	3	5	35	15
35	0	19	33	15	0	29	36	8	2	16	15	31
B. 1836	2	12	6	53	2	10	22	39	1	26	52	38
37	6	21	29	56	3	21	2	29	1	7	32	55
38	11	0	53	0	5	1	42	20	0	18	13	12
39	3	10	16	4	6	12	22	11	11	28	53	28
B. 1840	8	2	49	42	7	23	8	42	11	9	30	35
41	0	12	12	45	9	3	48	32	10	20	10	52
42	4	21	35	49	10	14	28	23	10	0	51	9
43	9	0	58	53	11	25	8	14	9	11	31	25
B. 1844	1	23	32	31	1	5	54	45	8	22	8	32
45	6	2	55	34	2	16	34	35	8	2	48	49
46	10	12	18	38	3	27	14	26	7	13	29	6
47	2	21	41	42	5	7	54	17	6	24	9	22
B. 1848	7	14	15	20	6	18	40	48	6	4	46	29
49	11	23	38	23	7	29	20	38	5	15	26	46
50	4	3	1	27	9	10	0	29	4	26	7	3
51	8	12	24	31	10	20	40	20	4	6	47	19
B. 1852	1	4	58	9	0	1	26	51	3	17	24	26

Mean MOTIONS of the MOON, for MONTHS and DAYS.

Days.	JANUARY. M. Mot. ☽		Ap.	☊ retr.	FEBRUARY. M. Mot. ☽	Ap.	☊ retr	MARCH. M Mot. ☽	Ap.	☊ retr.
	s ° ′ ″		° ′ ″	° ′ ″	s ° ′ ″	° ′ ″	° ′ ″	s ° ′ ″	° ′ ″	° ′ ″
1	0 13 10 35		0 6 41	0 3 11	2 1 38 41	3 33 54	1 41 41	2 10 35 2	6 41 4	3 10 38
2	0 26 21 10		0 13 22	0 6 21	2 14 49 16	3 40 35	1 44 52	2 23 45 36	6 47 45	3 13 49
3	1 9 31 45		0 20 3	0 9 32	2 27 59 51	3 47 16	1 48 2	3 6 56 12	6 54 26	3 17 0
4	1 22 42 20		0 26 44	0 12 43	3 11 10 26	3 53 57	1 51 13	3 20 6 46	7 1 7	3 20 11
5	2 5 52 55		0 33 25	0 15 53	3 24 21 1	4 0 38	1 54 24	4 3 17 21	7 7 48	3 23 21
6	2 19 3 30		0 40 6	0 19 4	4 7 31 36	4 7 19	1 57 34	4 16 27 57	7 14 30	3 26 32
7	3 2 14 5		0 46 47	0 22 14	4 20 42 11	4 14 0	2 0 44	4 29 38 32	7 21 11	3 29 43
8	3 15 24 40		0 53 29	0 25 25	5 3 52 46	4 20 42	2 3 55	5 12 49 7	7 27 51	3 32 53
9	3 28 35 15		1 0 10	0 28 36	5 17 3 21	4 27 23	2 7 6	5 25 59 42	7 34 32	3 36 4
10	4 11 45 50		1 6 51	0 31 46	6 0 13 56	3 34 4	2 10 16	6 9 10 17	7 41 13	3 39 14
11	4 24 56 25		1 13 32	0 34 57	6 13 24 31	4 40 45	2 13 27	6 22 20 52	7 47 54	3 42 25
12	5 8 7 0		1 20 13	0 38 8	6 26 35 6	4 47 26	2 16 38	7 5 31 27	7 54 35	3 45 36
13	5 21 17 35		1 26 54	0 41 18	7 9 45 41	4 54 7	2 19 49	7 18 42 2	8 1 17	0 48 46
14	6 4 28 10		1 33 35	0 44 29	7 22 56 16	5 0 48	2 22 59	8 1 52 37	8 7 58	3 51 56
15	6 17 38 45		1 40 16	0 47 40	8 6 6 51	5 7 29	2 26 10	8 15 3 12	8 14 39	3 55 8
16	7 0 49 20		1 46 57	0 50 50	8 19 17 26	5 14 10	2 29 20	8 28 13 47	8 21 20	3 58 17
17	7 13 59 55		1 53 38	0 54 1	9 2 28 1	5 20 51	2 32 31	9 11 24 22	8 28 1	4 1 29
18	7 27 10 30		2 0 19	0 57 11	9 15 38 36	5 27 32	2 35 41	9 24 34 57	8 34 42	4 4 39
19	8 10 21 5		2 7 0	1 0 22	9 28 49 11	5 34 13	2 38 52	10 7 45 32	8 41 23	4 7 49
20	8 23 31 41		2 13 41	1 3 33	10 11 59 46	5 40 55	2 42 2	10 20 56 7	8 48 4	4 11 0
21	9 6 42 15		2 20 22	1 6 43	10 25 10 21	5 47 36	2 45 13	11 4 6 42	8 54 46	4 14 11
22	9 19 52 51		2 27 4	1 9 54	11 8 20 56	5 54 17	2 48 24	11 17 17 17	9 1 28	4 17 21
23	10 3 3 26		2 33 45	1 13 5	11 21 31 31	6 0 58	2 51 35	0 0 27 52	9 8 8	4 20 32
24	10 16 14 1		2 40 26	1 16 15	0 4 42 6	6 7 39	2 54 45	0 13 38 27	9 14 49	4 23 43
25	10 29 24 36		2 47 7	1 19 26	0 17 52 41	6 14 20	2 57 56	0 26 49 2	9 21 30	4 26 54
26	11 12 35 11		2 53 48	1 22 37	1 1 3 17	6 21 1	3 1 7	1 9 59 37	9 28 11	4 30 5
27	11 25 45 46		3 0 29	1 25 47	1 14 13 52	6 27 42	3 4 17	1 23 10 12	9 34 52	4 33 15
28	0 8 56 21		3 7 10	1 28 58	1 27 24 26	6 34 23	3 7 28	2 6 20 47	9 41 33	4 36 26
29	0 22 6 56		3 13 51	1 32 9	In Leap Year take out for a Day fooner in *January* and *February*.			2 19 31 22	9 48 14	4 39 37
30	1 5 17 31		3 20 32	1 35 19				3 2 41 57	9 54 55	4 42 47
31	1 18 28 6		3 27 13	1 38 30				3 15 52 32	10 1 36	4 45 57

Mean MOTIONS of the MOON, for Months and Days, to Thirds of a DEGREE, for the correct Construction of the above Monthly Tables.

Days.	Months.		M. Mot. ☽.	M. Mot. Ap. ☽.	M. Mot. ☊ ☽. r.
			s ° ′ ″ ‴	s ° ′ ″ ‴	s ° ′ ″ ‴
	Jan.	0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0
31	Feb.	0	1 18 28 5 43	0 3 27 13 9	0 1 38 29 48
59	Mar.	0	1 27 24 26 22	0 6 34 23 7	0 3 7 27 40
90	Apr.	0	3 15 52 32 5	0 10 1 36 17	0 4 45 57 28
120	May	0	4 21 10 2 47	0 13 22 8 22	0 6 21 16 38
151	June	0	6 9 38 8 30	0 16 49 21 32	0 7 59 46 26
181	July	0	7 14 55 39 12	0 20 9 53 38	0 9 35 5 35
212	Aug.	0	9 3 23 44 55	0 23 37 6 47	0 11 13 35 23
243	Sept.	0	10 21 51 50 42	0 27 4 19 57	0 12 52 5 11
273	Octo.	0	11 27 9 21 20	1 0 24 52 3	0 14 27 24 20
304	Nov.	0	1 15 37 27 4	1 3 52 5 12	0 16 5 54 8
334	Dec.	0	2 20 54 57 46	1 7 12 37 18	0 17 41 13 17

Days	M. Mot. ☽.	M. Mot. Ap. ☽.	M Mot. ☊ ☽.
	s ° ′ ″ ‴	s ° ′ ″ ‴	s ° ′ ″ ‴
1	0 13 10 35 1	0 0 6 41 4	0 0 3 10 38
2	0 26 21 10 3	0 0 13 22 8	0 0 6 21 16
3	1 9 31 45 4	0 0 20 3 12	0 0 9 31 55
4	1 22 42 20 5	0 0 26 44 16	0 0 12 42 33
5	2 5 52 55 7	0 0 33 25 21	0 0 15 53 11
6	2 19 3 30 8	0 0 40 6 25	0 0 19 3 50
7	3 2 14 5 10	0 0 46 47 29	0 0 22 14 28
8	3 15 24 40 11	0 0 53 28 33	0 0 25 25 6
9	3 28 35 15 12	0 1 0 9 38	0 0 28 35 45
10	4 11 45 50 14	0 1 6 50 42	0 0 31 46 23
11	4 24 56 25 15	0 1 13 31 46	0 0 34 57 1
12	5 8 7 0 17	0 1 20 12 50	0 0 38 7 40

Mean MOTIONS of the MOON, for Months and Days.

Days.	APRIL. M. Mot. ☽.	APRIL. Apog.	APRIL. ☊ retr.	MAY. M. Mot. ☽	MAY. Apog.	MAY. ☊ retr.	JUNE. M. Mot. ☽.	JUNE. Apog.	JUNE. ☊ retr.
	s ° ′ ″	° ′ ″	° ′ ″	s ° ′ ″	° ′ ″	° ′ ″	s ° ′ ″	° ′ ″	° ′ ″
1	3 29 3 7	10 8 17	4 49 8	5 4 20 37	13 28 49	6 24 27	6 22 48 43	16 56 3	8 2 58
2	4 12 13 42	10 14 58	4 52 18	5 17 31 12	13 35 30	6 27 38	7 5 59 18	17 2 44	8 6 8
3	4 25 24 17	10 21 39	4 55 30	6 0 41 48	13 42 12	6 30 49	7 19 9 53	17 9 24	8 9 19
4	5 8 34 52	10 28 21	4 58 40	6 13 52 23	13 48 52	6 34 0	8 2 20 28	17 16 5	8 12 29
5	5 21 45 28	10 35 1	5 1 50	6 27 2 58	13 55 33	6 37 10	8 15 31 3	17 22 46	8 15 40
6	6 4 56 3	10 41 42	5 5 1	7 10 13 33	14 2 15	6 40 20	8 28 41 38	17 29 27	8 18 51
7	6 18 6 38	10 48 24	5 8 12	7 23 24 8	14 8 56	6 43 31	9 11 52 13	17 36 9	8 22 1
8	7 1 17 13	10 55 5	5 11 22	8 6 34 43	14 15 37	6 46 42	9 25 2 49	17 42 50	8 25 12
9	7 14 27 47	11 1 46	5 14 33	8 19 45 18	14 22 18	6 49 52	10 8 13 24	17 49 31	8 28 23
10	7 27 38 23	11 8 27	5 17 44	9 2 55 53	14 28 59	6 53 3	10 21 23 59	17 56 12	8 31 34
11	8 10 48 58	11 15 8	5 20 54	9 16 6 28	14 35 40	6 56 14	11 4 34 34	18 2 53	8 34 44
12	8 23 59 32	11 21 49	5 24 6	9 29 17 3	14 42 21	6 59 25	11 17 45 9	18 9 34	8 37 55
13	9 7 10 8	11 28 30	5 27 16	10 12 27 38	14 49 2	7 2 35	0 0 55 44	18 16 15	8 41 5
14	9 20 20 43	11 35 11	5 30 27	10 25 38 13	14 55 43	7 5 46	0 14 6 19	18 22 56	8 44 16
15	10 3 31 17	11 41 52	5 33 37	11 8 48 48	15 2 24	7 8 56	0 27 16 54	18 29 38	8 47 27
16	10 16 41 52	11 48 33	5 36 48	11 21 59 23	15 9 5	7 12 7	1 10 27 29	18 36 18	8 50 37
17	10 29 52 28	11 55 14	5 39 59	0 5 9 58	15 15 46	7 15 18	1 23 38 4	18 42 59	8 53 48
18	11 13 3 2	12 1 55	5 43 9	0 18 20 33	15 22 28	7 18 28	2 6 48 39	18 49 41	8 56 58
19	11 26 13 38	12 8 36	5 46 20	1 1 31 8	15 29 9	7 21 39	2 19 59 14	18 56 21	9 0 9
20	0 9 24 13	12 15 17	5 49 31	1 14 41 43	15 35 50	7 24 50	3 3 9 49	19 3 2	9 3 20
21	0 22 34 47	12 21 59	5 52 41	1 27 52 18	15 42 3	7 28 0	3 16 20 25	19 9 44	9 6 30
22	1 5 45 23	12 28 40	5 55 53	2 11 2 54	15 49 12	7 31 11	3 29 31 0	19 16 25	9 9 41
23	1 18 55 57	12 35 21	5 59 3	2 24 13 28	15 55 53	7 34 22	4 12 41 35	19 23 6	9 12 51
24	2 2 6 33	12 42 2	6 2 14	3 7 24 3	16 2 34	7 37 32	4 25 52 9	19 29 47	9 16 2
25	2 15 17 8	12 48 43	6 5 24	3 20 34 38	16 9 15	7 40 43	5 9 2 44	19 36 28	9 19 13
26	2 28 27 43	12 55 24	6 8 35	4 3 45 13	16 15 56	7 43 54	5 22 13 19	19 43 9	9 22 23
27	3 11 38 17	13 2 5	6 11 45	4 16 55 48	16 22 37	7 47 4	6 5 23 54	19 49 50	9 25 34
28	3 24 48 52	13 8 46	6 14 56	5 0 6 23	16 29 10	7 50 15	6 18 34 29	19 56 31	9 28 45
29	4 7 59 28	13 15 27	6 18 6	5 13 16 58	16 35 59	7 53 25	7 1 45 4	20 3 12	9 31 55
30	4 21 10 3	13 22 8	6 21 17	5 26 27 33	16 42 40	7 56 36	7 14 55 30	20 9 54	9 35 6
31				6 9 38 8	16 49 22	7 59 46			

Mean MOTIONS of the Moon for Days, to Thirds of a Degree, for the correct Construction of the above Monthly Tables, continued.

Days	M. Mot. ☽.	M. Mot. Ap. ☽.	M. Mot. ☊ ☽ r.	Days	M. Mot. ☽.	M. Mot. Ap. ☽.	M. Mot. ☊ ☽ r.
	s ° ′ ″ ‴	s ° ′ ″ ‴	s ° ′ ″ ‴		s ° ′ ″ ‴	s ° ′ ″ ‴	s ° ′ ″ ‴
13	5 21 17 35 18	0 1 26 53 54	0 0 41 18 18	23	10 3 3 25 22	0 2 33 44 36	0 1 13 4 41
14	6 4 28 10 19	0 1 33 34 58	0 0 44 28 56	24	10 16 14 0 33	0 2 40 25 40	0 1 16 15 19
15	6 17 38 45 21	0 1 40 16 3	0 0 47 39 35	25	10 29 24 35 35	0 2 47 6 44	0 1 19 25 58
16	7 0 49 20 22	0 1 46 57 7	0 0 50 50 13	26	11 12 35 10 36	0 2 53 47 49	0 1 22 36 36
17	7 13 59 55 24	0 1 53 38 11	0 0 54 0 51	27	11 25 45 45 38	0 3 0 28 53	0 1 25 47 14
18	7 27 10 30 25	0 2 0 10 15	0 0 57 11 29	28	0 8 56 20 39	0 3 7 9 57	0 1 28 57 53
19	8 10 21 5 26	0 2 7 0 19	0 1 0 22 8	29	0 22 6 5 40	0 3 13 51 1	0 1 32 8 31
20	8 23 31 40 28	0 2 13 41 24	0 1 3 32 46	30	1 5 17 30 42	0 3 20 32 5	0 1 35 19 9
21	9 6 42 15 29	0 2 20 22 28	0 1 6 43 24	31	1 18 28 5 43	0 3 27 13 9	0 1 38 29 48
22	9 19 52 50 30	0 2 27 3 32	0 1 9 54 3				

EXAMPLE of the correct Construction of the above Monthly Tables.		M. Mot. ☽.	M. Mot. Ap. ☽.	M. Mot. ☊ ☽ r.
	August	9 3 23 44 55	0 23 37 6 47	0 11 13 35 23
	Days 20	8 23 31 40 28	0 2 13 41 24	0 1 3 32 46
Nearly the same, as by the uppermost Table.	August 20	5 26 55 25 23	0 25 50 48 11	0 12 17 8 9

Mean MOTIONS of the MOON, for MONTHS and DAYS.

Days.	JULY. Mean M. ☽ s	°	′	″	Ap. °	′	″	☊ retr. °	′	″
1	7	28	6	14	20	16	34	9	38	17
2	8	11	16	49	20	23	15	9	41	27
3	8	24	27	24	20	29	56	9	44	38
4	9	7	37	59	20	36	37	9	47	49
5	9	20	48	34	20	43	18	9	50	59
6	10	3	59	9	20	49	59	9	54	10
7	10	17	9	44	20	56	41	9	57	20
8	11	0	20	19	21	3	22	10	0	31
9	11	13	30	54	21	10	3	10	3	42
10	11	26	41	30	21	16	44	10	6	52
11	0	9	52	5	21	23	25	10	10	3
12	0	23	2	40	21	30	6	10	13	14
13	1	6	13	15	21	36	47	10	16	24
14	1	19	23	50	21	43	29	10	19	35
15	2	2	34	25	21	50	9	10	22	46
16	2	15	45	0	21	56	50	10	25	56
17	2	28	55	35	22	3	31	10	29	7
18	3	12	6	10	22	10	13	10	32	17
19	3	25	16	45	22	16	53	10	35	28
20	4	8	27	20	22	23	35	10	38	39
21	4	21	37	55	22	30	16	10	41	49
22	5	4	48	30	22	36	57	10	45	0
23	5	17	59	5	22	43	38	10	48	11
24	6	1	9	40	22	50	19	10	51	21
25	6	14	20	15	22	57	0	10	54	32
26	6	27	30	50	23	3	41	10	57	42
27	7	10	41	25	23	10	22	11	0	53
28	7	23	52	0	23	17	4	11	4	4
29	8	7	2	35	23	23	44	11	7	14
30	8	20	13	10	23	30	26	11	10	25
31	9	3	23	45	23	37	7	11	13	35

Days.	AUGUST. M. Mot. ☽ s	°	′	″	Ap. °	′	″	☊ retr. °	′	″
1	9	16	34	20	23	43	48	11	16	47
2	9	29	44	55	23	50	29	11	19	57
3	10	12	55	30	23	57	10	11	23	8
4	10	26	6	5	24	3	50	11	26	18
5	11	9	16	40	24	10	31	11	29	29
6	11	22	27	15	24	17	12	11	32	40
7	0	5	37	50	24	23	53	11	35	50
8	0	18	48	25	24	30	35	11	39	1
9	1	1	59	0	24	37	16	11	42	12
10	1	15	9	35	24	43	57	11	45	22
11	1	28	20	10	24	50	38	11	48	33
12	2	11	30	45	24	57	19	11	51	44
13	2	24	41	20	25	4	0	11	54	54
14	3	7	51	55	25	10	41	11	58	5
15	3	21	2	30	25	17	22	12	1	16
16	4	4	13	5	25	24	3	12	4	26
17	4	17	23	40	25	30	44	12	7	37
18	5	0	34	15	25	37	25	12	10	47
19	5	13	44	50	25	44	6	12	13	58
20	5	26	55	25	25	50	47	12	17	9
21	6	10	6	0	25	57	29	12	20	19
22	6	23	16	35	26	4	10	12	23	30
23	7	6	27	10	26	10	51	12	26	40
24	7	19	37	45	26	17	32	12	29	51
25	8	2	48	20	26	24	13	12	33	2
26	8	15	58	55	26	30	54	12	36	13
27	8	29	9	30	26	37	35	12	39	23
28	9	12	20	5	26	44	16	12	42	34
29	9	25	30	40	26	50	57	12	45	43
30	10	8	41	15	26	57	38	12	48	55
31	10	21	51	51	27	4	20	12	52	5

Days.	SEPTEMBER. M. Mot. ☽ s	°	′	″	Ap. °	′	″	☊ retr. °	′	″
1	11	5	2	26	27	11	1	12	55	17
2	11	18	13	1	27	17	41	12	58	27
3	0	1	23	36	27	24	23	13	1	38
4	0	14	34	11	27	31	3	13	4	49
5	0	27	44	46	27	37	45	13	7	59
6	1	10	55	21	27	44	26	13	11	10
7	1	24	5	56	27	51	7	13	14	20
8	2	7	16	31	27	57	48	13	17	31
9	2	20	27	6	28	4	29	13	20	40
10	3	3	37	41	28	11	10	13	23	52
11	3	16	48	16	28	17	51	13	27	3
12	3	29	58	51	28	24	32	13	30	14
13	4	13	9	26	28	31	13	13	33	24
14	4	26	20	1	28	37	54	13	36	35
15	5	9	30	36	28	44	35	13	39	46
16	5	22	41	11	28	51	16	13	42	56
17	6	5	51	46	28	57	57	13	46	7
18	6	19	2	21	29	4	38	13	49	17
19	7	2	12	57	29	11	19	13	52	28
20	7	15	23	31	29	18	0	13	55	39
21	7	28	34	7	29	24	42	13	58	49
22	8	11	44	41	29	31	23	14	2	0
23	8	24	55	16	29	38	4	14	5	11
24	9	8	5	51	29	44	45	14	8	21
25	9	21	16	26	29	51	26	14	11	32
26	10	17	27	1	29	58	7	14	14	42
27	10	17	37	36	30	4	48	14	17	53
28	11	0	48	11	30	11	29	14	21	4
29	11	13	58	46	30	18	10	14	24	14
30	11	27	9	21	30	24	52	14	27	24

From Sept. 27, *the Motion* ☽'s *Apogee is expressed in Degrees* for Sig. and Deg.

EXAMPLE I.

To find the Mean Place of the ☽, *Apogee and Node, for* Octob. 12*th, at Noon,* 1772 *N. S.*

	☽ s	°	′	″	Ap. s	°	′	″	☊ s	°	′	″	
N. S. Year 1772.	7	23	52	24	11	16	12	32	7	4	42	16	
Mot. Octob. 12.	5	5	16	21	1	1	45	4		15	5	33	—
N. S. Octob. 12, 1772.	0	29	8	45	0	17	57	36	6	19	36	43	required.

EXAMPLE II.

To find the Mean Place of the ☽, *Apogee and Node for* Octob. 1*st, at Noon,* 1772 *O. S.*

	s	°	′	″	s	°	′	″	s	°	′	″	
O. S. Year 1700.	6	5	58	7	9	27	37	10	5	16	44	13	
Mot. Years 72.	6	12	50	42	1	19	48	54	10	12	36	54	
Mot. Oct. 1.	0	10	19	56	0	30	31	32		14	30	36	
									10	27	7	30	—
O. S. Octob. 1, 1772.	0	29	8	45	0	17	57	36	6	19	36	43	required.

Mean MOTIONS of the MOON for MONTHS and DAYS.

OCTOBER.

Days.	M. Mot. ☽. s	°	′	″	Ap. °	′	″	☊ retr. °	′	″
1	0	10	19	56	30	31	32	14	30	36
2	0	23	30	31	30	38	13	14	33	46
3	1	6	41	6	30	44	54	14	36	57
4	1	19	51	41	30	51	35	14	40	8
5	2	3	2	16	30	58	16	14	43	18
6	2	16	12	51	31	4	57	14	46	29
7	2	29	23	26	31	11	39	14	49	39
8	3	12	34	1	31	18	20	14	52	50
9	3	25	44	36	31	25	1	14	56	1
10	4	8	55	11	31	31	42	14	59	11
11	4	22	5	46	31	38	23	15	2	22
12	5	5	16	21	31	45	4	15	5	33
13	5	18	26	56	31	51	45	15	8	43
14	6	1	37	31	31	58	27	15	11	54
15	6	14	48	6	32	5	8	15	15	5
16	6	27	58	41	32	11	49	15	18	15
17	7	11	9	16	32	18	30	15	21	26
18	7	24	19	51	32	25	11	15	24	36
19	8	7	30	26	32	31	52	15	27	47
20	8	20	41	1	32	38	33	15	30	58
21	9	3	51	36	32	45	14	15	34	8
22	9	17	2	11	32	51	55	15	37	19
23	10	0	12	46	32	58	36	15	40	29
24	10	13	23	21	33	5	17	15	43	40
25	10	26	33	56	33	11	58	15	46	51
26	11	9	44	31	33	18	39	15	50	1
27	11	22	55	6	33	25	20	15	53	12
28	0	6	5	41	33	32	2	15	56	22
29	0	19	16	16	33	38	43	15	59	33
30	1	2	26	51	33	45	24	16	2	44
31	1	15	37	27	33	52	5	16	5	54

NOVEMBER.

Days.	M. Mot. ☽. s	°	′	″	Ap. °	′	″	☊ retr. °	′	″
1	1	28	48	1	33	58	46	16	9	6
2	2	11	58	36	34	5	27	16	12	16
3	2	25	9	12	34	12	8	16	15	27
4	3	8	19	47	34	18	49	16	18	38
5	3	21	30	22	34	25	30	16	21	48
6	4	4	40	57	34	32	11	16	24	59
7	4	17	51	32	34	38	53	16	28	9
8	5	1	2	7	34	45	34	16	31	20
9	5	14	12	42	34	52	15	16	34	31
10	5	27	23	17	34	58	56	16	37	41
11	6	10	33	52	35	5	37	16	40	52
12	6	23	44	27	35	12	18	16	44	3
13	7	6	55	2	35	18	59	16	47	13
14	7	20	5	37	35	25	40	16	50	24
15	8	3	16	12	35	32	21	16	53	35
16	8	16	26	47	35	39	2	16	56	45
17	8	29	37	22	35	45	43	16	59	56
18	9	12	47	57	35	52	24	17	3	6
19	9	25	58	32	35	59	5	17	6	17
20	10	9	9	7	36	5	46	17	9	28
21	10	22	19	42	36	12	28	17	12	38
22	11	5	30	17	36	19	9	17	15	49
23	11	18	40	52	36	25	50	17	19	0
24	0	1	51	27	36	32	31	17	22	10
25	0	15	2	2	36	39	12	17	25	21
26	0	28	12	37	36	45	53	17	28	32
27	1	11	23	12	36	52	34	17	31	42
28	1	24	33	47	36	59	15	17	34	53
29	2	7	44	22	37	5	56	17	38	3
30	2	20	54	58	37	12	37	17	41	13
31										

DECEMBER.

Days.	M. Mot. ☽. s	°	′	″	Ap. °	′	″	☊ retr. °	′	″
1	3	4	5	32	37	19	18	17	44	25
2	3	17	16	7	37	25	59	17	47	35
3	4	0	26	42	37	32	40	17	50	46
4	4	13	37	17	37	39	21	17	53	57
5	4	26	47	52	37	46	2	17	57	7
6	5	9	58	27	37	52	43	18	0	18
7	5	23	9	2	37	59	25	18	3	28
8	6	6	19	37	38	6	6	18	6	39
9	6	19	30	12	38	12	47	18	9	50
10	7	2	40	47	38	19	28	18	13	0
11	7	15	51	22	38	26	9	18	16	11
12	7	29	1	57	38	32	50	18	19	22
13	8	12	12	32	38	39	31	18	22	32
14	8	25	23	7	38	46	12	18	25	43
15	9	8	33	42	38	52	53	18	28	54
16	9	21	44	17	38	59	34	18	32	4
17	10	4	54	52	39	6	15	18	35	15
18	10	18	5	28	39	12	56	18	38	25
19	11	1	16	3	39	19	37	18	41	36
20	11	14	26	38	39	26	18	18	44	47
21	11	27	37	13	39	33	0	18	47	57
22	0	10	47	48	39	39	41	18	51	8
23	0	23	58	23	39	46	22	18	54	19
24	1	7	8	58	39	53	3	18	57	29
25	1	20	19	33	39	59	44	19	0	40
26	2	3	30	8	40	6	25	19	3	51
27	2	16	40	43	40	13	6	19	7	1
28	2	29	51	18	40	19	47	19	10	12
29	3	13	1	53	40	26	28	19	13	22
30	3	26	12	28	40	33	9	19	16	33
31	4	9	23	3	40	39	50	19	19	43

Motion of Moon's Apogee, in this Page, for Signs and Degrees is expreſſed in Degrees.

RADICAL MEAN PLACES and MOTIONS of the MOON, from ſeveral AUTHORITIES.

M. Pl. ☽. Julian Style. Jan. 0. 1701. (s ° ′ ″)	M.Pl.Ap. ☽. Julian Style. Jan. 0. 1701. (s ° ′ ″)	M.Pl.☊ ☽. Julian Style. Jan. 0. 1701. (s ° ′ ″)	M.Pl. ☽ à ☉ Julian Style. Jan. 0. 1701. (s ° ′ ″)	M. Mot. ☽ in 100 Julian Years. (s ° ′ ″)	M.Mot.Ap. ☽ in 100 Jul. Years. (s ° ′ ″)	M. Mot. ☊ ☽ ret. in 100 Jul. Years. r. (s ° ′ ″)	M. Mot. ☽ à ☉ in 100 Jul. Years. (s ° ′ ″)	According to
10 15 21 0 GREENWICH	11 8 20 0 OBSERVATO	4 27 24 20 RY.	0 24 37 20	10 7 50 25 1336 Revol.	3 19 11 15 11 Revol.	4 14 11 15 5 Revol.	10 7 5 5 1236 Revol.	Sir *Iſaac Newton*'s laſt Edition *Principia.*
10 15 20 0	11 8 20 0	4 27 23 20	0 24 36 27	10 7 50 25	3 19 11 15	4 14 11 15	10 7 4 52 40‴	Dr. *Ed. Halley*'s Tables.
10 15 21 10	11 8 15 0	4 27 24 30	0 24 37 17	Same . .	GREENW.	OBSERV.	. . . 30	*Gael Morris*, Aſſ. Aſt. R.
10 15 15 42	11 8 17 52	4 27 28 32	0 24 32 7	10 7 52 20	3 19 11 15 PARIS	4 14 11 15 OBSERV.	10 7 6 33	*Tobias Mayer*, of *Gottingen*, *Germany*, from his Tables.
10 15 21 30 LON	11 8 6 30 DON.	4 27 26 20	0 24 35 59	10 7 50 25	3 19 11 15	4 14 11 15	10 7 4 25	*Leonard Euler*, of *Berlin*, *Pruſſia*, F. R. S. from his Tables.
10 15 16 30	11 8 5 0	4 27 18 30	0 24 36 9	10 7 48 45	3 19 10 0	4 14 12 30	10 7 5 20	*Thomas Street*'s Caroline Tables.
10 15 21 10 GREENWICH	11 8 17 0 OBSERVATO	4 27 24 30 RY, for wh.	0 24 37 27 Place *our*	10 7 50 25 Solar *Radixes*	3 19 11 15 are alſo	4 14 11 15 fitted, and	10 7 4 53 *others* as for	Our own Tables, Above.

Hence, From a *Compariſon* of Theſe, with other *Obſervations*, we give the following correct

RADICAL MEAN PLACES and MOTIONS of the MOON, for *Julian* and *Gregorian* YEARS.

Julian Style. Years before & since Christ.	M. Places ☽. s	°	′	″	M. Pl. Ap. ☽. s	°	′	″	M. Pl. ☊. s	°	′	″
B. 1000	5	4	16	52	7	19	33	25	6	9	47	58
B. 900	3	12	7	17	11	8	44	40	1	25	36	43
B. 800	1	19	57	42	2	27	55	55	9	11	25	28
B. 700	11	27	48	7	6	17	7	10	4	27	14	13
B. 600	10	5	38	32	10	6	18	25	0	13	2	58
B. 500	8	13	28	57	1	25	29	40	7	28	51	43
B. 400	6	21	19	22	5	14	40	55	3	14	40	28
B. 300	4	29	9	47	9	3	52	10	11	0	29	13
B. 200	3	7	0	12	0	23	3	25	6	16	17	58
B. Jul. Per. 100	1	14	50	37	4	12	14	40	2	2	6	43
B. 4713. B.C. 0	11	22	41	2	8	1	25	55	9	17	55	28
B. 100	10	0	31	27	11	20	37	10	5	3	44	13
B. 200	8	8	21	52	3	9	48	25	0	19	32	58
B. 300	6	16	12	17	6	28	59	40	8	5	21	43
B. 400	4	24	2	42	10	18	10	55	3	21	10	28
B. 500	3	1	53	7	2	7	22	10	11	6	59	13
B. 600	1	9	43	32	5	26	33	25	6	22	47	58
B. 700	11	17	33	57	9	15	44	40	2	8	36	43
B. 800	9	25	24	22	1	4	55	55	9	24	25	28
B. 900	8	3	14	47	4	24	7	10	5	10	14	13
B. 1000	6	11	5	12	8	13	18	25	0	26	2	58
B. 1100	4	18	55	37	0	2	29	40	8	11	51	43
B. 1200	2	26	46	2	3	21	40	55	3	27	40	28
B. 1300	1	4	36	27	7	10	52	10	11	13	29	13
B. 1400	11	12	26	52	11	0	3	25	6	29	17	58
B. 1500	9	20	17	17	2	19	14	40	2	15	6	43
B. 1600	7	28	7	42	6	8	25	55	10	0	55	28
B. 1700	6	5	58	7	9	27	37	10	5	16	44	13
B. 1800	4	13	48	32	1	16	48	25	1	2	32	58
B. 1900	2	21	38	57	5	5	59	40	8	18	21	43
B. 2000	0	29	29	22	8	25	10	55	4	4	10	28

Bissextile Years Places are advanced a Day's Motion.

Greg. Style. Yrs of Christ.	M. Places ☽. s	°	′	″	M. Pl. Ap. ☽. s	°	′	″	M. Pl. ☊. s	°	′	″
B. 1600	3	16	21	52	6	7	19	4	10	1	27	14
1700	1	11	1	42	9	26	23	38	5	17	19	10
1800	11	5	41	32	1	15	28	12	1	3	11	5
1900	9	0	21	22	5	4	32	46	8	19	3	1
B. 2000	7	8	11	47	8	23	44	1	4	4	51	46
2100	5	2	51	37	0	12	48	35	11	20	43	42
2200	2	27	31	27	4	1	53	9	7	6	35	37
2300	0	22	11	17	7	20	57	43	2	22	27	33
B. 2400	11	0	1	42	11	10	8	58	10	8	16	18
2500	8	24	41	32	2	29	13	32	5	24	8	14
2600	6	19	21	22	6	18	18	6	1	10	0	9
2700	4	14	1	12	10	7	22	40	8	25	52	5
B. 2800	2	21	51	37	1	26	33	55	4	11	40	50
2900	0	16	31	27	5	15	38	29	11	27	32	46
3000	10	11	11	17	9	4	43	3	7	13	24	41
3100	8	5	51	7	0	23	47	37	2	29	16	37
B. 3200	6	13	41	32	4	12	58	52	10	15	5	22
3300	4	8	21	22	8	2	3	26	6	0	57	18
3400	2	3	1	12	11	21	8	0	1	16	49	13

Bissextile Years Places are advanced a Day's Motion.

From Hundreds of Years *Gregorian* deduct their *Fourth* (rejecting Fractions) and the *Remainder* will be equal to the N°. of Days there are *less* in any N°. of *Gregorian* Years than are in the same N°. of Years *Julian*, since 1600. Whence the Diff. of Motion between any N°. of *Julian* and *Gregorian* Years is determined.

EXAMPLES.

In the Year 2735.	In the Year 2215
—1600	—1600
¼ 11|35	¼ 6|15
— 2	— 1
9 Days less in 11 Hund. Years *Greg.*	5 Days less in 6 Hundred Years *Gregorian.*

Julian Years.	M. Mot. ☽. s	°	′	″	Mean Mot. Ap. ☽. s	°	′	″	Mean Mot. ☊ retr. s	°	′	″
B. 100	10	7	50	25	3	19	11	15	4	14	11	15
B. 200	8	15	40	50	7	8	22	30	8	28	22	30
B. 300	6	23	31	15	10	27	33	45	1	12	33	45
B. 400	5	1	21	40	2	16	45	0	5	26	45	0
B. 500	3	9	12	5	6	5	56	15	10	10	56	15
B. 600	1	17	2	30	9	25	7	30	2	25	7	30
B. 700	11	24	52	55	1	14	18	45	7	9	18	45
B. 800	10	2	43	20	5	3	30	0	11	23	30	0
B. 900	8	10	33	45	8	22	41	15	4	7	41	15
B. 1000	6	18	24	10	0	11	52	30	8	21	52	30
B. 2000	1	6	48	20	0	23	45	0	5	13	45	0
B. 3000	7	25	12	30	1	5	37	30	2	5	37	30
B. 4000	2	13	36	40	1	17	30	0	10	27	30	0
B. 5000	9	2	0	50	1	29	22	30	7	19	22	30
B. 6000	3	20	25	0	2	11	15	0	4	11	15	0

Greg. Years.	M. Mot. ☽. s	°	′	″	Mean Mot. Ap. ☽. s	°	′	″	Mean Mot. ☊ retr. s	°	′	″
100	9	24	39	50	3	19	4	34	4	14	8	4
200	7	19	19	40	7	8	9	8	8	28	16	9
300	5	13	59	30	10	27	13	42	1	12	24	13
B. 400	3	21	49	55	2	16	24	57	5	26	35	28
B. 800	7	13	39	50	5	2	49	54	11	23	10	56
B. 1200	11	5	29	45	7	19	14	51	5	19	46	24
B. 1600	2	27	19	40	10	5	39	48	11	16	21	52
B. 2000	6	19	9	35	0	22	4	45	5	12	57	20
B. 2400	10	10	59	30	3	8	29	42	11	9	32	48
B. 2800	2	2	49	25	5	24	54	39	5	6	8	16
B. 3200	5	24	39	20	8	11	19	36	11	2	43	44
B. 3600	9	16	29	15	10	27	44	33	4	29	19	12
B. 4000	1	8	19	10	1	4	9	30	10	25	54	40
B. 6000	7	27	28	45	1	26	14	15	4	8	52	0

Mean

Mean MOTION of the MOON, for 99 *Julian* YEARS.

Julian Years.	Mean Mot. ☽.				Apogee ☽.				☊ ret.			
	s	°	′	″	s	°	′	″	s	°	′	″
1	4	9	23	3	1	10	39	50	0	19	19	43
2	8	18	46	7	2	21	19	41	1	8	39	26
3	0	28	9	11	4	1	59	32	1	27	59	10
B. 4	5	20	42	49	5	12	46	3	2	17	22	3
5	10	0	5	52	6	23	25	53	3	6	41	46
6	2	9	28	56	8	4	5	44	3	26	1	29
7	6	18	52	0	9	14	45	35	4	15	21	13
B. 8	11	11	25	38	10	25	32	6	5	4	44	6
9	3	20	48	41	0	6	11	56	5	24	3	49
10	8	0	11	45	1	16	51	47	6	13	23	32
11	0	9	34	49	2	27	31	38	7	2	43	16
B. 12	5	2	8	27	4	8	18	9	7	22	6	9
13	9	11	31	30	5	18	57	59	8	11	25	52
14	1	20	54	34	6	29	37	50	9	0	45	35
15	6	0	17	38	8	10	17	41	9	20	5	19
B. 16	10	22	51	16	9	21	4	12	10	9	28	12
17	3	2	14	19	11	1	44	2	10	28	47	55
18	7	11	37	23	0	12	23	53	11	18	7	38
19	11	21	0	27	1	23	3	44	0	7	27	22
B. 20	4	13	34	5	3	3	50	15	0	26	50	15
21	8	22	57	8	4	14	30	5	1	16	9	58
22	1	2	20	12	5	25	9	56	2	5	29	41
23	5	11	43	16	7	5	49	47	2	24	49	25
B. 24	10	4	16	54	8	16	36	18	3	14	12	18
25	2	13	39	57	9	27	16	8	4	3	32	1
26	6	23	3	1	11	7	55	59	4	22	51	44
27	11	2	26	5	0	18	35	50	5	12	11	28
B. 28	3	24	59	43	1	29	22	21	6	1	34	21
29	8	4	22	46	3	10	2	11	6	20	54	4
30	0	13	45	50	4	20	42	2	7	10	13	47
31	4	23	8	54	6	1	21	53	7	29	33	31
B. 32	9	15	42	32	7	12	8	24	8	18	56	24
33	1	25	5	35	8	22	48	14	9	8	16	7
34	6	4	28	39	10	3	28	5	9	27	35	50
35	10	13	51	43	11	14	7	56	10	16	53	34
B. 36	3	6	25	21	0	24	54	27	11	6	18	27
37	7	15	48	24	2	5	34	17	11	25	38	10
38	11	25	11	28	3	16	14	8	0	14	57	53
39	4	4	34	32	4	26	53	59	1	4	17	37
B. 40	8	27	8	10	6	7	40	30	1	23	40	30
41	1	0	31	13	7	18	20	20	2	13	0	13
42	5	15	54	17	8	29	0	11	3	2	19	56
43	9	25	17	21	10	9	40	2	3	21	39	40
B. 44	2	17	50	59	11	20	26	33	4	11	2	33
45	6	27	14	2	1	1	6	23	5	0	22	16
46	11	6	37	6	2	11	46	14	5	19	41	59
47	3	16	0	10	3	22	26	5	6	9	1	43
B. 48	8	8	33	48	5	3	12	36	6	28	24	36

Connect these Motions with Places for whole Hundreds, in either Style, for the present Year's Places.

Julian Years.	Mean Mot. ☽.				Apogee ☽.				☊ ret.			
	s	°	′	″	s	°	′	″	s	°	′	″
49	0	17	56	51	6	13	52	26	7	17	44	19
50	4	27	19	55	7	24	32	17	8	7	4	2
51	9	6	42	59	9	5	12	8	8	26	23	46
B. 52	1	29	16	37	10	15	58	39	9	15	46	39
53	6	8	39	40	11	26	38	29	10	5	6	22
54	10	18	2	44	1	7	18	20	10	24	26	5
55	2	27	25	48	2	17	58	11	11	13	55	49
B. 56	7	19	59	26	3	28	44	42	0	3	8	42
57	11	29	22	29	5	9	24	32	0	22	28	25
58	4	8	45	33	6	20	4	23	1	11	48	8
59	8	18	8	37	8	0	44	14	2	1	7	52
B. 60	1	10	42	15	9	11	30	45	2	20	30	45
61	5	20	5	18	10	22	10	35	3	9	50	28
62	9	29	28	22	0	2	50	26	3	29	10	11
63	2	8	51	26	1	13	30	17	4	18	29	55
B. 64	7	1	25	4	2	24	16	48	5	7	52	48
65	11	10	48	7	4	4	56	38	5	27	12	31
66	3	20	11	11	5	15	36	29	6	16	32	14
67	7	29	34	15	6	26	16	20	7	5	51	58
B. 68	0	22	7	53	8	7	2	51	7	25	14	51
69	5	1	30	56	9	17	42	41	8	14	34	34
70	9	10	54	0	10	28	22	32	9	3	54	17
71	1	20	17	4	0	9	2	23	9	23	14	1
B. 72	6	12	50	42	1	19	48	54	10	12	36	54
73	10	22	13	45	3	0	28	44	11	1	56	37
74	3	1	36	49	4	11	8	35	11	21	16	20
75	7	10	59	53	5	21	48	26	0	10	36	4
B. 76	0	3	33	31	7	2	34	57	0	29	58	57
77	4	12	56	34	8	13	14	47	1	19	18	40
78	8	22	19	38	9	23	54	38	2	8	38	23
79	1	1	42	42	11	4	34	29	2	27	58	7
B. 80	5	24	16	20	0	15	21	0	3	17	21	0
81	10	3	39	23	1	26	0	50	4	6	40	43
82	2	13	2	27	3	6	40	41	4	26	0	26
83	6	22	25	31	4	17	20	32	5	15	20	10
B. 84	11	14	59	9	5	28	7	3	6	4	43	3
85	3	24	22	12	7	8	46	53	6	24	2	46
86	8	3	45	16	8	19	26	44	7	13	22	29
87	0	13	8	20	10	0	6	35	8	2	42	13
B. 88	5	5	41	58	11	10	53	6	8	22	5	6
89	9	15	5	1	0	21	32	56	9	11	24	49
90	1	24	28	5	2	2	12	47	10	0	44	32
91	6	3	51	9	3	12	52	38	10	20	4	16
B. 92	10	26	24	47	4	23	39	9	11	9	27	9
93	3	5	47	50	6	4	18	59	11	28	46	52
94	7	15	10	54	7	14	58	50	0	18	6	35
95	11	24	33	58	8	25	38	41	1	7	26	19
B. 96	4	17	7	36	10	6	25	12	1	26	49	12
97	8	26	30	39	11	17	5	2	2	16	8	55
98	1	5	53	43	0	27	44	53	3	5	28	38
99	5	15	16	47	2	8	24	44	3	24	48	22

RADICAL *Mean* PLACES of the MOON, for *Years* and *Months, Old* and *New Style.*

1600 — Julian Style.

Months.	Ds.	Mean Pl. ☽ s	°	′	″	M. Pl. Ap. ☽ s	°	′	″	M. Pl. ☊ s	°	′	″
January	1	7	28	7	42	6	8	25	55	10	0	55	28
February	1	9	16	35	48	6	11	53	8	9	29	16	58
March	0	9	25	32	8	6	15	0	18	9	27	48	0
April	0	11	14	0	14	6	18	27	31	9	26	9	31
May	0	0	19	17	45	6	21	48	3	9	24	34	11
June	0	2	7	45	50	6	25	15	17	9	22	55	42
July	0	3	13	3	21	6	28	35	49	9	21	20	22
August	0	5	1	31	27	7	2	3	2	9	19	41	53
September	0	6	19	59	33	7	5	30	15	9	18	3	23
October	0	7	25	17	3	7	8	50	47	9	16	28	4
November	0	9	13	45	9	7	12	18	0	9	14	49	34
December	0	10	19	2	40	7	15	38	32	9	13	14	15

1600 — Gregorian Style.

Months.	Ds.	Mean. Pl. ☽ s	°	′	″	M. Pl. Ap. ☽ s	°	′	″	M. Pl. ☊ s	°	′	″
January	1	3	16	21	52	6	7	19	4	10	1	27	14
February	1	5	4	49	58	6	10	46	17	9	29	48	44
March	0	5	13	46	18	6	13	53	27	9	28	19	46
April	0	7	2	14	24	6	17	20	40	9	26	41	17
May	0	8	7	31	55	6	20	41	12	9	25	5	57
June	0	9	26	0	0	6	24	8	26	9	23	27	28
July	0	11	1	17	31	6	27	28	58	9	21	52	8
August	0	0	19	45	37	7	0	56	11	9	20	13	39
September	0	2	8	13	43	7	4	23	24	9	18	35	9
October	0	3	13	31	13	7	7	43	56	9	16	59	50
November	0	5	1	59	19	7	11	11	9	9	15	21	20
December	0	6	7	16	50	7	14	31	41	9	13	46	1

1700 — Julian Style.

Months.	Ds.	s	°	′	″	s	°	′	″	s	°	′	″
January	1	6	5	58	7	9	27	37	10	5	16	44	13
February	1	7	24	26	13	10	1	4	23	5	15	5	43
March	0	8	3	22	33	10	4	11	33	5	13	36	45
April	0	9	21	50	39	10	7	38	46	5	11	58	16
May	0	10	27	8	10	10	10	59	18	5	10	22	56
June	0	0	15	36	15	10	14	26	32	5	8	44	27
July	0	1	20	53	46	10	17	47	4	5	7	9	7
August	0	3	9	21	52	10	21	14	17	5	5	30	38
September	0	4	27	49	58	10	24	41	30	5	3	52	8
October	0	6	3	7	28	10	28	2	2	5	2	16	49
November	0	7	21	35	34	11	1	29	15	5	0	38	19
December	0	8	26	53	5	11	4	49	47	4	29	3	0

1700 — Gregorian Style.

Months.	Ds.	s	°	′	″	s	°	′	″	s	°	′	″
January	0	1	11	1	42	9	26	23	38	5	17	19	10
February	0	2	29	29	48	9	29	50	51	5	15	40	40
March	0	3	8	26	8	10	2	58	1	5	14	11	42
April	0	4	26	54	14	10	6	25	14	5	12	33	13
May	0	6	2	11	45	10	9	45	46	5	10	57	53
June	0	7	20	39	50	10	13	13	0	5	9	19	24
July	0	8	25	57	21	10	16	33	32	5	7	44	4
August	0	10	14	25	27	10	20	0	45	5	6	5	35
September	0	0	2	53	33	10	23	27	58	5	4	27	5
October	0	1	8	11	3	10	26	48	30	5	2	51	46
November	0	2	26	39	9	11	0	15	43	5	1	13	16
December	0	4	1	56	40	11	3	36	15	4	29	37	57

1800 — Julian Style.

Months.	Ds.	s	°	′	″	s	°	′	″	s	°	′	″
January	1	4	13	48	32	1	16	48	25	1	2	32	58
February	1	6	2	16	38	1	20	15	38	1	0	54	28
March	0	6	11	12	58	1	23	22	48	0	29	25	30
April	0	7	29	41	4	1	26	50	1	0	27	47	1
May	0	9	4	58	35	2	0	10	33	0	26	11	41
June	0	10	23	26	40	2	3	37	47	0	24	33	12
July	0	11	28	44	11	2	6	58	19	0	22	57	52
August	0	1	17	12	17	2	10	25	32	0	21	19	23
September	0	3	5	40	23	2	13	52	45	0	19	40	53
October	0	4	10	57	53	2	17	13	17	0	18	5	34
November	0	9	29	25	59	2	20	40	30	0	16	27	4
December	0	7	4	43	30	2	24	1	2	0	14	51	45

1800 — Gregorian Style.

Months.	Ds.	s	°	′	″	s	°	′	″	s	°	′	″
January	0	11	5	41	32	1	15	28	12	1	3	11	5
February	0	0	24	9	38	1	18	55	25	1	1	32	35
March	0	1	3	5	58	1	22	2	35	1	0	3	37
April	0	2	21	34	4	1	25	29	48	0	28	25	8
May	0	3	26	51	35	1	28	50	20	0	26	49	48
June	0	5	15	19	40	2	2	17	34	0	25	11	19
July	0	6	20	37	11	2	5	38	6	0	23	35	59
August	0	8	9	5	17	2	9	5	19	0	21	57	30
September	0	9	27	33	23	2	12	32	32	0	20	19	0
October	0	11	2	50	53	2	15	53	4	0	18	43	41
November	0	0	21	18	59	2	19	20	17	0	17	5	11
December	0	1	26	36	30	2	22	40	49	0	15	29	52

In Leap Year take out the Month Day Motions for *January* and *February* 1 Day sooner, in both Styles.

EXAMPLE.

To find the Mean Place ☽, *Apogee, and* ☊, *for* February 19, 1752, *at Noon, O. S.?*

	☽ Pl. s	°	′	″	Ap. ☽ s	°	′	″	☊ s	°	′	″
1700 *O. S. Feb.* 1.	7	24	26	13	10	1	4	23	5	15	5	43
52 Yrs. Mot.	1	29	16	37	10	15	58	39	9	15	46	39
B. Days 18.	7	27	10	30		2	0	19			57	11
Leap Year.									9	16	43	50
1752, *O. S. Feb.* 19	5	20	53	20	8	19	3	21	7	28	21	53

EXAMPLE.

To find the Mean Place ☽, *Apogee, and* ☊, *for* January 15, 1760, *at Noon, N. S.?*

	☽ Pl. s	°	′	″	Ap. ☽ s	°	′	″	☊ s	°	′	″
1700 *N. S. Jan.* 0.	1	11	1	42	9	26	23	38	5	17	19	10
60 Yrs. Mot.	1	10	42	15	9	11	30	45	2	20	30	45
B. Days 14.	6	4	28	10		1	33	35			41	18
Leap Year.									2	21	12	3
1760 *N. S. Jan.* 15	8	26	12	7	7	9	27	58	2	26	7	7

Mean Motion of the Moon continued, for Months, Days, &c.

Ds.	Mths.	M. Mot. ☽. s	°	′	″	M.Mo.Ap. ☽. s	°	′	″	M.Mot ☊ re. s	°	′	″
	Jan. 0	0	0	0	0	0	0	0	0	0	0	0	0
31	*Feb.* 0	1	18	28	6	0	3	27	13	0	1	38	30
59	*March* 0	1	27	24	26	0	6	34	23	0	3	7	28
90	*April* 0	3	15	52	32	0	10	1	36	0	4	45	57
120	*May* 0	4	21	10	3	0	13	22	8	0	6	21	17
151	*June* 0	6	9	38	8	0	16	49	22	0	7	59	46
181	*July* 0	7	14	55	39	0	20	9	54	0	9	35	6
212	*August* 0	9	3	23	45	0	23	37	7	0	11	13	35
243	*Sept.* 0	10	21	51	51	0	27	4	20	0	12	52	5
273	*Oct.* 0	11	27	9	21	1	0	24	52	0	14	27	24
304	*Nov.* 0	1	15	37	27	1	3	52	5	0	16	5	54
334	*Dec.* 0	2	20	54	58	1	7	12	37	0	17	41	13

Take out 1 Day sooner for *January* and *February*, in Leap-year.

Days	M. Mot. ☽. s	°	′	″	M.Mo.Ap. ☽. °	′	″	M.Mot ☊ re. °	′	″
1	0	13	10	35	0	6	41	0	3	11
2	0	26	21	10	0	13	22	0	6	21
3	1	9	31	45	0	20	3	0	9	32
4	1	22	42	20	0	26	44	0	12	43
5	2	5	52	55	0	33	25	0	15	53
6	2	19	3	30	0	40	6	0	19	4
7	3	2	14	5	0	46	47	0	22	14
8	3	15	24	40	0	53	29	0	25	25
9	3	28	35	15	1	0	10	0	28	36
10	4	11	45	50	1	6	51	0	31	46
11	4	24	56	25	1	13	32	0	34	57
12	5	8	7	0	1	20	13	0	38	8
13	5	21	17	35	1	26	54	0	41	18
14	6	4	28	10	1	33	35	0	44	29
15	6	17	38	45	1	40	16	0	47	40
16	7	0	49	20	1	46	57	0	50	50
17	7	13	59	55	1	53	38	0	54	1
18	7	27	10	30	2	0	19	0	57	11
19	8	10	21	5	2	7	0	1	0	22
20	8	23	31	40	2	13	41	1	3	33
21	9	6	42	15	2	20	22	1	6	43
22	9	19	52	50	2	27	4	1	9	54
23	10	3	3	26	2	33	45	1	13	5
24	10	16	14	0	2	40	26	1	16	15
25	10	29	24	36	2	47	7	1	19	26
26	11	12	35	11	2	53	48	1	22	37
27	11	25	45	46	3	0	29	1	25	47
28	0	8	50	21	3	7	10	1	28	58
29	0	22	6	56	3	13	51	1	32	9
30	1	5	17	31	3	20	32	1	35	19
31	1	18	28	6	3	27	13	1	38	30

Ex. 1. *To find the mean Places of the* ☽, *Apogee, and* ☊, *for* May 20th, $9^h\ 20^m\ 36^s$, P. M. 1759. O. S.

	M. Pl. ☽. s	°	′	″	Ap. ☽. s	°	′	″	☊. s	°	′	″
O. S. 1700	6	5	58	7	9	27	37	10	5	16	44	13
Mot. Yrs. 59	8	13	8	37	8	0	44	14	2	1	7	52
May – –	4	21	10	2	0	13	22	8	0	6	21	17
Days 20	8	23	31	40		2	13	41		1	3	33
Hours 9		4	56	28			2	30			1	11
Minutes 20			10	59				6				3
Seconds 36				20				0	2	8	33	56
M. Places O. S.	4	13	56	13	6	13	59	49	3	8	10	17
11 Days Mo.—	4	24	56	25	—	1	13	32		+	34	57
M. Places N. S.	11	18	59	48	6	12	46	17	3	8	45	14

H. / Min. / Sec.	M.Mo. ☽. ° / ′ / ″	′ / ″ / ‴	″ / ‴ / iv	Ap. ′ / ″ / ‴	″ / ‴ / iv	☊. ′ / ″ / ‴	″ / ‴ / iv
1	0	32	56	0	17	0	8
2	1	5	53	0	33	0	16
3	1	38	49	0	50	0	24
4	2	11	46	1	7	0	32
5	2	44	42	1	24	0	40
6	3	17	39	1	40	0	48
7	3	50	35	1	57	0	56
8	4	23	32	2	14	1	4
9	4	56	28	2	30	1	11
10	5	29	25	2	47	1	19
11	6	2	21	3	4	1	27
12	6	35	18	3	21	1	35
13	7	8	14	3	37	1	43
14	7	41	10	3	54	1	51
15	8	14	7	4	11	1	59
16	8	47	3	4	27	2	7
17	9	20	0	4	44	2	15
18	9	52	56	5	1	2	23
19	10	25	53	5	18	2	31
20	10	58	49	5	34	2	39
21	11	31	46	5	51	2	47
22	12	4	42	6	8	2	55
23	12	37	39	6	24	3	3
24	13	10	35	6	41	3	11
25	13	43	31	6	58	3	19
26	14	16	28	7	15	3	27
27	14	49	24	7	31	3	34
28	15	22	21	7	48	3	42
29	15	55	17	8	5	3	50
30	16	28	14	8	21	3	58

H. / Min. / Sec.	M.Mo. ☽. ° / ′ / ″	′ / ″ / ‴	″ / ‴ / iv	Ap. ′ / ″ / ‴	″ / ‴ / iv	☊. ′ / ″ / ‴	″ / ‴ / iv
31	17	1	10	8	38	4	6
32	17	34	7	8	54	4	14
33	18	7	3	9	11	4	22
34	18	39	59	9	28	4	30
35	19	12	55	9	45	4	38
36	19	45	52	10	2	4	46
37	20	18	48	10	19	4	54
38	20	51	45	10	35	5	2
39	21	24	41	10	52	5	10
40	21	57	38	11	8	5	18
41	22	30	34	11	25	5	26
42	23	3	31	11	42	5	34
43	23	36	27	11	59	5	42
44	24	9	24	12	16	5	50
45	24	42	20	12	32	5	57
46	25	15	17	12	48	6	5
47	25	48	13	13	5	6	13
48	26	21	10	13	22	6	21
49	26	54	6	13	39	6	29
50	27	27	3	13	56	6	37
51	27	59	59	14	13	6	45
52	28	32	56	14	30	6	53
53	29	5	52	14	46	7	1
54	29	38	49	15	2	7	9
55	30	11	45	15	19	7	17
56	30	44	42	15	36	7	25
57	31	17	38	15	53	7	33
58	31	50	34	16	10	7	41
59	32	23	31	16	26	7	49
60	32	6	27	16	43	7	57

Ex. 2. *To find the mean Places of* ☽, *Apogee, and* ☊, *for* February 23, 1896, N. S. *at Noon; answering to* February 11, 1896, O. S.?

	M. Pl. ☽. s	°	′	″	Ap. ☽. s	°	′	″	☊. s	°	′	″
O. S. 1800.	4	13	48	32	1	16	48	25	1	2	32	58
Mo. Yrs 96	4	17	7	36	10	6	25	12	1	26	49	12
Feb.	1	18	28	6	0	3	27	13	0	1	38	30
B. Days 10	4	11	45	50		1	6	51			31	46
									1	28	59	28
Places O. S.	3	1	10	4	11	27	47	41	11	3	33	30

The Answer.

Ex. 3. *To find the mean Places of the* ☽, *Apogee, and* ☊, *for* May 31st, $9^h\ 20^m\ 36^s$ N. S. *answering to the above Time,* O. S.?

	M. Pl. ☽.				Ap. ☽.				☊.			
N. S. 1700	1s	11°	1′	42″	9s	26°	23′	38″	5s	17°	19′	10″
Mot. Yrs. 59	8	18	8	37	8	0	44	14	2	1	7	52
May – –	4	21	10	2	0	13	22	8	0	6	21	17
Days 31	1	18	28	6		3	27	13		1	38	30
Hours 9		4	56	28			2	30			1	11
Minutes 20			10	59				6				3
Seconds 36				20				0	2	9	8	53
M. Places N. S.	4	13	56	14	6	13	59	49	3	8	10	17

The same as above.

l.

I. EQUATION of the MOON, or Annual Equation.

C.

Argument. SUN's Mean ANOMALY.

☉'s M. An.	SIGN 0.						SIGN 1.						SIGN 2.						☉'s M. An.
	☽ +	Dif.	Apog. —	Dif.	☊ +	Dif.	☽ +	Dif.	Apog. —	Dif.	☊ +	Dif.	☽ +	Dif.	Apog. —	Dif.	☊ +	Dif.	
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
0	0 00		0 00		0 00		5 33		12 46		4 36		9 44		22 16		8 1		30
1	0 12	12	0 26	26	0 10	10	5 43	10	13 9	23	4 44	8	9 50	6	22 30	14	8 6	5	29
2	0 24	12	0 53	27	0 19	9	5 53	10	13 32	23	4 52	8	9 56	6	22 44	14	8 11	5	28
3	0 35	11	1 19	26	0 29	10	6 3	10	13 55	23	5 0	8	10 2	6	22 58	14	8 16	5	27
4	0 47	11	1 47	26	0 39	10	6 13	10	14 18	23	5 8	8	10 7	5	23 10	12	8 20	4	26
5	0 58	11	2 13	26	0 48	9	6 23	10	14 40	22	5 16	8	10 13	6	23 21	11	8 24	4	25
6	1 10	12	2 40	27	0 57	9	6 33	10	15 1	21	5 24	8	10 18	5	23 33	12	8 28	4	24
7	1 21	11	3 6	26	1 7	10	6 43	10	15 22	21	5 32	8	10 23	5	23 44	11	8 32	4	23
8	1 33	12	3 32	26	1 17	10	6 52	9	15 43	21	5 40	8	10 28	5	23 55	11	8 36	4	22
9	1 44	11	3 59	27	1 26	9	7 1	9	16 4	21	5 48	8	10 33	5	24 5	10	8 40	4	21
10	1 55	11	4 25	26	1 36	10	7 10	9	16 28	22	5 56	8	10 38	5	24 14	9	8 44	4	20
11	2 7	12	4 51	26	1 45	9	7 19	9	16 47	21	6 3	7	10 42	4	24 24	10	8 47	3	19
12	2 18	11	5 17	26	1 55	10	7 28	9	17 7	20	6 10	7	10 46	4	24 33	9	8 50	3	18
13	2 30	12	5 43	26	2 4	9	7 37	9	17 27	20	6 17	7	10 50	4	24 42	9	8 53	3	17
14	2 41	11	6 9	26	2 14	10	7 45	8	17 47	20	6 24	7	10 54	4	24 50	8	8 56	3	16
15	2 52	11	6 35	26	2 23	9	7 54	9	18 7	20	6 31	7	10 51	3	24 57	7	8 58	2	15
16	3 3	11	7 1	26	2 32	9	8 3	9	18 26	19	6 38	7	11 0	3	25 5	8	9 1	3	14
17	3 14	11	7 27	26	2 41	9	8 11	8	18 44	18	6 45	7	11 3	3	25 12	7	9 3	2	13
18	3 25	11	7 52	25	2 50	9	8 19	8	19 3	19	6 52	7	11 6	3	25 18	6	9 6	3	12
19	3 36	11	8 18	26	2 59	9	8 27	8	19 21	18	6 58	6	11 8	2	25 25	7	9 8	2	11
20	3 47	11	8 44	26	3 8	9	8 35	8	19 39	18	7 4	6	11 11	3	25 30	5	9 10	2	10
21	3 58	11	9 9	25	3 17	9	8 43	8	19 57	18	7 10	6	11 13	2	25 35	5	9 12	2	9
22	4 9	11	9 33	24	3 26	9	8 50	7	20 14	17	7 16	6	11 15	2	25 39	4	9 13	1	8
23	4 20	11	9 58	25	3 35	9	8 58	8	20 30	16	7 22	6	11 17	2	25 44	5	9 15	2	7
24	4 31	11	10 22	24	3 44	9	9 5	7	20 46	16	7 28	6	11 19	2	25 48	4	9 16	1	6
25	4 42	11	10 47	25	3 52	8	9 12	7	21 2	16	7 34	6	11 21	2	25 51	3	9 17	1	5
26	4 52	10	11 11	24	4 1	9	9 19	7	21 18	16	7 39	5	11 22	1	25 53	2	9 18	1	4
27	5 2	10	11 35	24	4 10	9	9 25	6	21 33	15	7 45	5	11 23	1	25 51	2	9 19	1	3
28	5 13	11	11 59	24	4 18	8	9 32	7	21 48	15	7 51	6	11 24	1	25 57	2	9 20	1	2
29	5 23	10	12 22	23	4 27	9	9 38	6	22 2	14	7 56	5	11 25	1	25 59	2	9 20	0	1
30	5 33	10	12 46	24	4 36	9	9 44	6	22 16	14	8 1	5	11 25	0	26 0	1	9 21	1	0
☉'s M. An.	— ☽	Dif.	+ Apog.	Dif.	— ☊	Dif.	— ☽	Dif.	+ Apog.	Dif.	— ☊	Dif.	— ☽	Dif.	+ Apog.	Dif.	— ☊	Dif.	☉'s M. An.
	SIGN 11.						SIGN 10.						SIGN 9.						

For the CONSTRUCTION, fee the COMMENT on the MOON's THEORY.

I. EQUATION of the MOON, or Annual Equation. C.

Argument. SUN's Mean ANOMALY.

☉'s M. An.	SIGN 3.						SIGN 4.						SIGN 5.						☉'s M. An.
	☽ +	Dif.	Apog. −	Dif.	☊ +	Dif.	☽ +	Dif.	Apog. −	Dif.	☊ +	Dif.	☽ +	Dif.	Apog. −	Dif.	☊ +	Dif.	
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
0	11 25		26 0		9 21		10 2		22 45		8 10		5 52		13 14		4 45		30
1	11 25	0	26 0	0	9 21	0	9 56	6	22 32	13	8 6	4	5 41	11	12 50	24	4 37	8	29
2	11 25	0	26 0	0	9 21	0	9 50	6	22 18	14	8 1	5	5 30	11	12 25	25	4 28	9	28
3	11 24	1	25 59	1	9 20	1	9 43	7	22 3	15	8 56	5	5 19	11	12 1	24	4 19	9	27
4	11 24	0	25 58	1	9 20	0	9 37	6	21 48	15	7 51	5	5 8	11	11 37	24	4 10	9	26
5	11 23	1	25 56	2	9 20	0	9 30	7	21 32	16	7 46	5	4 57	11	11 12	25	4 1	9	25
6	11 23	0	25 54	2	9 19	1	9 23	7	21 17	15	7 41	5	4 46	11	10 46	26	3 52	9	24
7	11 22	1	25 52	2	9 18	1	9 16	7	21 2	15	7 35	6	4 35	11	10 21	25	3 44	8	23
8	11 21	1	25 49	3	9 17	1	9 9	7	20 45	17	7 29	6	4 24	11	9 55	26	3 35	9	22
9	11 20	1	25 45	4	9 16	1	9 2	7	20 28	17	7 22	7	4 12	12	9 29	26	3 26	9	21
10	11 18	2	25 41	4	9 15	1	8 55	7	20 11	17	7 16	6	4 0	12	9 3	26	3 16	10	20
11	11 16	2	25 36	5	9 13	2	8 47	8	19 53	18	7 9	7	3 49	11	8 37	26	3 6	10	19
12	11 14	2	25 31	5	9 11	2	8 39	8	19 35	18	7 3	6	3 37	12	8 11	26	2 56	10	18
13	11 12	2	25 26	5	9 9	2	8 31	8	19 17	18	6 57	6	3 26	11	7 45	26	2 47	9	17
14	11 10	2	25 21	5	9 7	2	8 23	8	18 59	18	6 50	7	3 14	12	7 19	26	2 38	9	16
15	11 7	3	25 15	5	9 5	2	8 15	8	18 39	20	6 43	7	3 2	12	6 52	27	2 28	10	15
16	11 4	3	25 8	7	9 3	2	8 7	8	18 20	19	6 36	7	2 51	11	6 25	27	2 18	10	14
17	11 1	3	25 0	8	9 0	3	7 58	9	18 0	20	6 29	7	2 39	12	5 58	27	2 9	9	13
18	10 57	4	24 52	8	8 57	3	7 49	9	17 40	20	6 22	7	2 26	13	5 31	27	1 59	10	12
19	10 54	3	24 44	8	8 54	3	7 40	9	17 20	20	6 15	7	2 14	12	5 4	27	1 49	10	11
20	10. 50	4	24 35	9	8 50	4	7 31	9	16 59	21	6 7	8	2 2	12	4 37	27	1 40	9	10
21	10 46	4	24 26	9	8 47	3	7 22	9	16 38	21	5 59	8	1 50	12	4 10	27	1 30	10	9
22	10 41	5	24 17	9	8 44	3	7 13	9	16 16	22	5 51	8	1 38	12	3 42	28	1 20	10	8
23	10 37	4	24 7	10	8 40	4	7 4	9	15 55	21	5 44	7	1 26	12	3 14	28	1 10	10	7
24	10 33	4	23 56	11	8 37	3	6 54	10	15 33	22	5 36	8	1 14	12	2 46	28	1 0	10	6
25	10 28	5	23 46	10	8 33	4	6 44	10	15 11	22	5 28	8	1 1	13	2 18	28	0 50	10	5
26	10 23	5	23 34	12	8 29	4	6 33	11	14 48	23	5 19	9	0 49	12	1 50	28	0 40	10	4
27	10 18	5	23 23	11	8 25	4	6 23	10	14 24	24	5 11	8	0 37	12	1 23	27	0 30	10	3
28	10 13	5	23 11	12	8 20	5	6 12	11	14 1	23	5 3	8	0 25	12	0 56	27	0 20	10	2
29	10 8	5	22 58	13	8 15	5	6 2	10	13 38	23	4 54	9	0 13	12	0 28	28	0 10	10	1
30	10 2	6	22 45	13	8 10	5	5 52	10	13 14	24	4 45	9	0 0	13	0 0	28	0 0	10	0
☉'s M. An.	− ☽	Dif.	+ Apog.	Dif.	− ☊	Dif.	− ☽	Dif.	+ Apog.	Dif.	− ☊	Dif.	− ☽	Dif.	+ Apog.	Dif.	− ☊	Dif.	☉'s M. An.
	SIGN 8.						SIGN 7.						SIGN 6.						

For the CONSTRUCTION, fee the COMMENT on the MOON's THEORY.

II. Equation of the Moon, or I. *Semiannual.*

C.

Argument. Sun from MOON's APOGEE.

☉ à ☽'s Ap.	Sig. 0. −	D.	Sig. 1. −	D.	Sig. 2. −	D.	Sig. 3. ∓	D.	Sig. 4. +	D.	Sig. 5. +	D.	☉ à ☽'s Ap.
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
0	0 00		5 4		5 17		0 30		4 27		4 39		30
1	0 13	13	5 11	7	5 11	6	0 18	12	4 33	6	4 33	6	29
2	0 26	13	5 17	6	5 5	6	0 6	12	4 38	5	4 27	6	28
3	0 39	13	5 23	6	4 58	7	0—6	12	4 43	5	4 21	6	27
4	0 52	13	5 30	7	4 51	7	0 18	12	4 47	4	4 15	6	26
5	1 4	12	5 35	5	4 44	7	0 30	12	4 52	5	4 8	7	25
6	1 16	12	5 39	4	4 37	7	0 41	11	4 56	4	4 1	7	24
7	1 28	12	5 43	4	4 29	8	0 52	11	5 0	4	3 54	7	23
8	1 40	12	5 47	4	4 21	8	0 3	11	5 4	4	3 46	8	22
9	1 51	11	5 50	3	4 13	8	1 14	11	5 7	3	3 38	8	21
10	2 3	12	5 53	3	4 4	9	1 25	11	5 10	3	3 30	8	20
11	2 14	11	5 55	2	3 55	9	1 36	11	5 12	2	3 21	9	19
12	2 25	11	5 57	2	3 46	9	1 47	11	5 14	2	3 12	9	18
13	2 36	11	5 58	1	3 37	9	1 59	12	5 15	1	3 2	10	17
14	2 47	11	5 59	1	3 27	10	2 10	11	5 16	1	2 52	10	16
15	2 57	10	5 59	0	3 17	10	2 20	10	5 16	0	2 42	10	15
16	3 7	10	5 59	0	3 7	10	2 30	10	5 16	0	2 32	10	14
17	3 17	10	5 58	1	2 57	10	2 40	10	5 15	1	2 22	10	13
18	3 27	10	5 58	0	2 46	11	2 50	10	5 15	0	2 12	10	12
19	3 36	9	5 57	1	2 35	11	2 59	9	5 14	1	2 2	10	11
20	3 45	9	5 56	1	2 24	11	3 9	10	5 13	1	1 51	11	10
21	3 54	9	5 54	2	2 13	11	3 18	9	5 12	1	1 40	11	9
22	4 3	9	5 51	3	2 2	11	3 27	9	5 10	2	1 30	10	8
23	4 12	9	5 49	2	1 51	11	3 36	9	5 7	3	1 19	11	7
24	4 20	8	5 46	3	1 40	11	3 48	8	5 4	3	1 8	11	6
25	4 28	8	5 42	4	1 29	11	3 56	8	5 0	4	0 57	11	5
26	4 36	8	5 38	4	1 18	11	4 3	7	4 56	4	0 46	11	4
27	4 43	7	5 43	5	1 6	12	4 10	7	4 52	4	0 35	11	3
28	4 50	7	5 28	5	0 54	12	4 16	6	4 48	4	0 24	11	2
29	4 57	7	5 23	5	0 42	12	4 22	6	4 44	4	0 12	12	1
30	5 4	7	5 17	6	0 30	12	4 27	5	4 39	5	0 0	12	0
☉ à ☽'s Ap.	+	D.	+	D.	+	D.	±	D.	−	D.	−	D.	☉ à ☽'s Ap.
	Sig. 11.		Sig. 10.		Sig. 9.		Sig. 8.		Sig. 7.		Sig. 6.		

III. Equat. Moon.

C.

Arg. Sun à Moon's Node.

Arg. proper.	S. 0, 6 −	S. 1, 7 −	S. 2, 8 −	Arg. prop.
°	′ ″	′ ″	′ ″	°
0	0 0	0 41	0 41	30
1	0 2	0 41	0 40	29
2	0 3	0 42	0 39	28
3	0 5	0 43	0 38	27
4	0 7	0 44	0 37	26
5	0 8	0 44	0 36	25
6	0 10	0 45	0 35	24
7	0 11	0 45	0 34	23
8	0 13	0 46	0 33	22
9	0 15	0 46	0 31	21
10	0 16	0 46	0 30	20
11	0 18	0 47	0 29	19
12	0 19	0 47	0 28	18
13	0 21	0 47	0 26	17
14	0 22	0 47	0 25	16
15	0 24	0 47	0 24	15
16	0 25	0 47	0 22	14
17	0 26	0 47	0 21	13
18	0 28	0 47	0 19	12
19	0 29	0 47	0 18	11
20	0 30	0 46	0 16	10
21	0 31	0 46	0 15	9
22	0 33	0 46	0 13	8
23	0 34	0 45	0 11	7
24	0 35	0 45	0 10	6
25	0 36	0 44	0 8	5
26	0 37	0 43	0 7	4
27	0 38	0 43	0 5	3
28	0 39	0 42	0 3	2
29	0 40	0 41	0 2	1
30	0 41	0 41	0 0	0
Arg. proper.	S. 5, 11 +	S. 4, 10 +	S. 3, 9 +	Arg. prop.

For the CONSTRUCTION, see the COMMENT on the MOON's THEORY.

	IV. Equat. Moon. C.			V. Eq. Moon. C.			VI. Eq. Moon. C.			VII. Equat. Moon. C.			
	Arg. Mean *Evection* + 2 ☉ à ☽'s ☊.			*Arg.* Mean *Evection* + 2 ☽ M. Anom.			*Arg.* Mean *Evection* + ☉ M. Anom.			*Arg.* Mean *Evection* — ☉ M. Anom.			
Arg. proper.	S. 0 +, 6 —	S. 1 +, 7 —	S. 2 +, 8 —	S. 0 +, 6 —	S. 1 +, 7 —	S. 2 +, 8 —	S. 0 +, 6 —	S. 1 +, 7 —	S. 2 +, 8 —	S. 0 +, 6 —	S. 1 +, 7 —	S. 2 +, 8 —	Arg. proper.
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	0 30	0 52	0 0	0 42	1 14	0 0	1 12	2 5	0 0	0 50	1 28	30
1	0 1	0 31	0 52	0 1	0 44	1 14	0 2	1 15	2 7	0 2	0 52	1 29	29
2	0 2	0 32	0 53	0 2	0 46	1 15	0 5	1 17	2 8	0 4	0 54	1 30	28
3	0 3	0 32	0 53	0 4	0 47	1 15	0 7	1 19	2 9	0 6	0 56	1 31	27
4	0 4	0 33	0 54	0 6	0 48	1 16	0 10	1 21	2 10	0 8	0 57	1 32	26
5	0 5	0 34	0 54	0 8	0 49	1 16	0 12	1 23	2 11	0 9	0 58	1 33	25
6	0 6	0 35	0 55	0 10	0 50	1 17	0 15	1 25	2 12	0 11	1 0	1 33	24
7	0 7	0 36	0 55	0 12	0 51	1 17	0 17	1 27	2 13	0 12	1 1	1 34	23
8	0 8	0 36	0 56	0 13	0 52	1 18	0 20	1 29	2 14	0 14	1 2	1 35	22
9	0 9	0 37	0 56	0 14	0 53	1 18	0 22	1 31	2 15	0 16	1 4	1 35	21
10	0 10	0 38	0 56	0 15	0 54	1 19	0 25	1 33	2 16	0 18	1 5	1 36	20
11	0 11	0 39	0 57	0 17	0 55	1 19	0 27	1 35	2 17	0 20	1 6	1 36	19
12	0 12	0 39	0 57	0 18	0 56	1 20	0 30	1 37	2 17	0 21	1 8	1 36	18
13	0 13	0 40	0 57	0 19	0 57	1 20	0 32	1 39	2 18	0 22	1 9	1 37	17
14	0 14	0 41	0 58	0 20	0 58	1 21	0 35	1 41	2 19	0 24	1 10	1 37	16
15	0 15	0 42	0 58	0 21	0 59	1 21	0 37	1 43	2 20	0 26	1 11	1 38	15
16	0 16	0 42	0 58	0 22	1 0	1 22	0 40	1 44	2 20	0 28	1 13	1 38	14
17	0 17	0 43	0 58	0 23	1 1	1 22	0 42	1 46	2 21	0 30	1 14	1 39	13
18	0 18	0 44	0 59	0 25	1 2	1 22	0 44	1 48	2 21	0 31	1 15	1 39	12
19	0 19	0 45	0 59	0 26	1 3	1 23	0 46	1 49	2 22	0 33	1 17	1 39	11
20	0 20	0 46	0 59	0 28	1 4	1 23	0 49	1 51	2 22	0 35	1 18	1 40	10
21	0 28	0 47	0 59	0 30	1 5	1 23	0 51	1 52	2 23	0 37	1 19	1 40	9
22	0 22	0 47	0 59	0 31	1 6	1 24	0 54	1 54	2 23	0 39	1 20	1 40	8
22	0 23	0 48	1 0	0 33	1 7	1 24	0 56	1 55	2 24	0 40	1 21	1 40	7
24	0 24	0 48	1 0	0 35	1 8	1 24	0 59	1 57	2 24	0 42	1 22	1 40	6
25	0 25	0 49	1 0	0 36	1 9	1 24	1 1	1 58	2 24	0 43	1 23	1 41	5
26	0 26	0 49	1 0	0 37	1 10	1 25	1 3	2 0	2 24	0 45	1 24	1 41	4
27	0 27	0 50	1 0	0 38	1 11	1 25	1 5	2 1	2 25	0 46	1 25	1 41	3
28	0 28	0 51	1 0	0 40	1 12	1 25	1 8	2 3	2 25	0 48	1 26	1 41	2
29	0 29	0 51	1 0	0 41	1 13	1 25	1 10	2 4	2 25	0 49	1 27	1 41	1
30	0 30	0 52	1 0	0 42	1 14	1 25	1 12	2 5	2 25	0 50	1 28	1 41	0
Arg. proper.	S. 5 +, 11 —	S. 4 +, 10 —	S. 3 +, 9 —	S. 4 +, 11 —	S. 4 +, 10 —	S. 3 +, 9 —	S. 5 +, 11 —	S. 4 +, 10 —	S. 3 +, 9 —	S. 5 +, 11 —	S. 4 +, 10 —	S. 3 +, 9 —	Arg. proper.

N. B. *Mean Evection* is ☽ *M. Anom.* — 2. ☉ *à* ☽ *Apogee.*

For the CONSTRUCTION, see the COMMENT on the MOON's THEORY.

VIII. Mean Elliptic EQUATION of the MOON's CENTER, according to ,05505 the Mean Eccentricity of her Orbit to Radius 1; or of 55050 Eccentricity to Sem. Transf. 1000000, or mean Distance à ⊖.
C.

Argument. MOON's corrected ANOMALY.

☽ cor. An.	Sign 0. —	Dif.	Sig. 1. —	Dif.	Sig. 2. —	Dif.	Sig. 3. —	Dif.	Sig. 4. —	Dif.	Sig. 5. —	Dif.	☽ cor. An.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	6 11	2 58 30	5 28	5 16 25	3 28	6 17 44	0 24	5 38 54	3 5	3 21 6	5 59	30
1	0 6 11	6 11	3 3 58	5 26	5 19 53	3 21	6 18 8	0 17	5 35 49	3 13	3 15 7	6 3	29
2	0 12 22	6 10	3 9 24	5 22	5 23 14	3 16	6 18 25	0 10	5 32 36	3 19	3 9 4	6 7	28
3	0 18 32	6 10	3 14 46	5 19	5 26 30	3 12	6 18 35	0 3	5 29 17	3 27	3 2 57	6 13	27
4	0 24 42	6 10	3 20 5	5 16	5 29 42	3 6	6 18 38	0 4	5 25 50	3 32	2 56 44	6 15	26
5	0 30 52	6 10	3 25 21	5 14	5 32 48	3 0	6 18 34	0 11	5 22 18	3 39	2 50 29	6 18	25
6	0 37 2	6 9	3 30 35	5 10	5 35 48	2 55	6 18 23	0 18	5 18 39	3 46	2 44 11	6 23	24
7	0 43 11	6 8	3 35 45	5 6	5 38 43	2 39	6 18 5	0 24	5 14 53	3 52	2 37 48	6 25	23
8	0 49 19	6 7	3 40 51	5 4	5 41 32	2 43	6 17 41	0 32	5 11 1	3 58	2 31 23	6 30	22
9	0 55 26	6 6	3 45 55	5 0	5 44 15	2 38	6 17 9	0 39	5 7 3	4 6	2 24 53	6 33	21
10	1 1 32	6 6	3 50 55	4 55	5 46 53	2 32	6 16 30	0 45	5 2 57	4 11	2 18 20	6 37	20
11	1 7 38	6 5	3 55 50	4 53	5 49 25	2 26	6 15 45	0 53	4 58 46	4 17	2 11 45	6 39	19
12	1 13 43	6 3	4 0 43	4 49	5 51 51	2 20	6 14 52	1 0	4 54 29	4 24	2 5 6	6 41	18
13	1 19 46	6 2	4 5 32	4 45	5 54 11	2 13	6 13 52	1 8	4 50 5	4 30	1 58 25	6 44	17
14	1 25 48	6 2	4 10 17	4 40	5 56 24	2 8	6 12 44	1 14	4 45 35	4 36	1 51 41	6 47	16
15	1 31 50	6 0	4 14 57	4 37	5 58 32	2 2	6 11 30	1 21	4 40 59	4 41	1 44 54	6 49	15
16	1 37 50	5 58	4 19 34	4 33	6 0 34	1 55	6 10 9	1 29	4 36 18	4 47	1 38 5	6 51	14
17	1 43 48	5 57	4 24 7	4 29	6 2 29	1 49	6 8 40	1 35	4 31 31	4 54	1 31 14	6 53	13
18	1 49 45	5 55	4 28 36	4 26	6 4 18	1 44	6 7 5	1 42	4 26 37	4 58	1 24 21	6 55	12
19	1 55 40	5 53	4 33 0	4 20	6 6 2	1 36	6 5 23	1 49	4 21 39	5 5	1 17 26	6 55	11
20	2 1 33	5 51	4 37 20	4 16	6 7 58	1 30	6 3 34	1 57	4 16 34	5 9	1 10 29	6 58	10
21	2 7 24	5 50	4 41 36	4 11	6 9 8	1 24	6 1 37	2 3	4 11 25	5 16	1 3 31	7 1	9
22	2 13 14	5 47	4 45 47	4 6	6 10 32	1 17	5 59 34	2 11	4 6 9	5 20	0 56 30	7 1	8
23	2 19 1	5 45	4 49 53	4 2	6 11 49	1 11	5 57 23	2 17	4 0 49	5 25	0 49 29	7 1	7
24	2 24 46	5 44	4 53 55	3 58	6 13 0	1 4	5 55 6	2 25	3 55 24	5 32	0 42 28	7 3	6
25	2 30 30	5 41	4 57 53	3 52	6 14 4	0 57	5 52 41	2 31	3 49 52	5 36	0 35 25	7 4	5
26	2 36 11	5 38	5 1 45	3 47	6 15 1	0 51	5 50 10	2 38	3 44 16	5 40	0 28 21	7 5	4
27	2 41 49	5 35	5 5 32	3 43	6 15 52	0 44	5 47 32	2 46	3 38 36	5 46	0 21 16	7 5	3
28	2 47 20	5 32	5 9 15	3 37	6 16 36	0 37	5 44 46	2 53	3 32 50	5 50	0 14 11	7 5	2
29	2 52 58	5 32	5 12 52	3 33	6 17 13	0 31	5 41 53	2 59	3 27 0	5 54	0 7 6	7 6	1
30	2 58 30		5 16 25		6 17 44		5 38 54		3 21 6		0 0 0		0
☽ cor. An.	+	Dif.	+	Dif.	+	Dif.	+	Dif.	+	Dif.	+	Dif.	☽ cor. An.
	Sig. 11.		Sig. 10.		Sig. 9.		Sig. 8.		Sig. 7.		Sig. 6.		

Ex. *To find the Equation to* 1ˢ 18° ☽ *corrected Anomaly?*

		Com. Log.
Construction, ½ Arg. corrected An. . . .	24° 0′ 0″	
By Tab. for red. com. Eq. ☽ . . C. Eq. . .	+ 1 23 p. 82.	
Equated ½ Anomaly. . .	24 1 23 Tan.	9.6490533
Const. Log. +		9.9521358
From the cor. ½ Anom. deduct ½ tr. An.	21 45 42 Tan.	9.6011891
Difference —	2 14 18 = ½ Equat.	
Doubled . .	4 28 36 = the true Equation, req.	

See further on, for our universal and accurate Solution of the Keplerian *Problem.*

N. B. In the { first / last } 6 Signs when the { true / cor. } An. sub. fr: { cor. / true } the Sign of Equation is { — / + }

N. B. *The Moon's corrected Anomaly, or above Argument, is her mean Anomaly corrected by the* VII. *foregoing, or* First Equations.

IX. EVECTION-EQUATION of the MOON: Or Second EQUATION of the MOON's CENTER.

C.

Argument. True Evection; Or M. Evection ∓ ½ M. Equation of the MOON's Center, according to its Title.

True E-vec.	Sign 0. —	Dif.	Sig. 1. —	Dif.	Sig. 2. —	Dif.	Sig. 3. —	Dif.	Sig. 4. —	Dif.	Sig. 5. —	Dif.	True E-vec.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	1 24	0 39 42	1 12	1 9 7	0 42	1 20 25	0 1	1 10 9	0 42	0 40 43	1 13	30
1	0 1 24	1 23	0 40 54	1 11	1 9 49	0 41	1 20 26	0 1	1 9 27	0 43	0 39 30	1 14	29
2	0 2 47	1 23	0 42 5	1 11	1 10 30	0 40	1 20 25	0 3	1 8 44	0 45	0 38 16	1 16	28
3	0 4 10	1 23	0 43 16	1 10	1 11 10	0 39	1 20 22	0 4	1 7 59	0 46	0 37 0	1 17	27
4	0 5 33	1 23	0 44 26	1 9	1 11 49	0 36	1 20 18	0 5	1 7 13	0 46	0 35 43	1 17	26
5	0 6 56	1 23	0 45 35	1 8	1 12 25	0 36	1 20 13	0 7	1 6 27	0 48	0 34 26	1 17	25
6	0 8 19	1 23	0 46 43	1 7	1 11 1	0 34	1 20 6	0 8	1 5 39	0 50	0 33 9	1 18	24
7	0 9 42	1 22	0 47 50	1 6	1 13 35	0 33	1 19 58	0 10	1 4 49	0 51	0 31 51	1 19	23
8	0 11 4	1 22	0 48 56	1 5	1 14 8	0 32	1 19 48	0 11	1 3 58	0 53	0 30 32	1 19	22
9	0 12 26	1 22	0 50 1	1 5	1 14 40	0 31	1 19 37	0 13	1 3 5	0 54	0 29 13	1 20	21
10	0 13 48	1 22	0 51 6	1 4	1 15 11	0 29	1 19 24	0 14	1 2 11	0 54	0 27 53	1 20	20
11	0 15 10	1 21	0 52 10	1 3	1 15 40	0 28	1 19 10	0 16	1 1 17	0 56	0 26 33	1 21	19
12	0 16 30	1 20	0 53 13	1 2	1 16 8	0 26	1 18 54	0 17	1 0 31	0 57	0 25 12	1 22	18
13	0 17 51	1 20	0 54 15	1 1	1 16 34	0 25	1 18 37	0 19	0 59 24	0 58	0 23 50	1 22	17
14	0 19 11	1 20	0 55 16	1 0	1 16 59	0 23	1 18 18	0 19	0 58 26	0 59	0 22 28	1 22	16
15	0 20 31	1 20	0 56 16	1 0	1 17 22	0 22	1 17 59	0 22	0 57 27	1 0	0 21 7	1 23	15
16	0 21 51	1 20	0 57 16	0 58	1 17 44	0 21	1 17 37	0 23	0 56 27	1 1	0 19 44	1 23	14
17	0 23 11	1 19	0 58 14	0 57	1 18 5	0 19	1 17 14	0 24	0 55 26	1 2	0 18 21	1 24	13
18	0 24 30	1 19	0 59 11	0 56	1 18 24	0 18	1 16 50	0 26	0 54 24	1 3	0 16 57	1 24	12
19	0 25 49	1 18	1 0 7	0 55	1 18 42	0 17	1 16 24	0 27	0 53 21	1 5	0 15 33	1 24	11
20	0 27 7	1 18	1 1 2	0 54	1 18 59	0 15	1 15 57	0 29	0 52 16	1 5	0 14 10	1 24	10
21	0 28 25	1 18	1 1 56	0 52	1 19 14	0 14	1 15 28	0 30	0 51 11	1 6	0 12 47	1 24	9
22	0 29 43	1 17	1 2 48	0 52	1 19 28	0 12	1 14 58	0 31	0 50 5	1 7	0 11 22	1 25	8
23	0 31 0	1 16	1 3 40	0 51	1 19 40	0 11	1 14 27	0 33	0 48 58	1 8	0 9 57	1 25	7
24	0 32 16	1 16	1 4 31	0 49	1 19 51	0 9	1 13 54	0 34	0 47 50	1 9	0 8 32	1 25	6
25	0 33 32	1 15	1 5 20	0 48	1 20 0	0 8	1 13 20	0 36	0 46 41	1 10	0 7 7	1 25	5
26	0 34 47	1 15	1 6 8	0 47	1 20 8	0 6	1 12 44	0 37	0 45 31	1 10	0 5 42	1 25	4
27	0 36 2	1 14	1 6 55	0 45	1 20 14	0 5	1 12 7	0 38	0 44 21	1 12	0 4 18	1 25	3
28	0 37 16	1 13	1 7 40	0 44	1 20 19	0 4	1 11 29	0 39	0 43 9	1 13	0 2 52	1 26	2
29	0 38 29	1 13	1 8 24	0 43	1 20 23	0 2	1 10 50	0 41	0 41 56	1 13	0 1 26	1 26	1
30	0 39 42		1 9 7		1 20 25		1 10 9		0 40 43		0 0 0		0
True E-vec.	+ Sig. 11.	Dif.	+ Sig. 10.	Dif.	+ Sig. 9.	Dif.	+ Sig. 8.	Dif.	+ Sig. 7.	Dif.	+ Sig. 6.	Dif.	True E-vec.

N. B. *M. Anom.* ☽, ± ½ *M. Equat.* ☽ *Center,* (otherwise called ½ the elliptic Equation) *according to its Title, will be the* ECCENTRIC ANOMALY *of the Moon.*

And the Eccentric *Anomaly* ☽ — 2. ☉ *à* ☽*'s Apogee, will be the* Argument *of the* EVECTION EQUATION *of the Moon, as above.*

For the CONSTRUCTION, see the COMMENT on the MOON's THEORY.

X. COMPOUND VARIATION-EQUATION of the MOON.

C.

Argument. MOON Equated from the SUN's True PLACE.

☽ eq. à ☉ true.	Sig. 0.				Sig. 1.				Sig. 2.				Sig. 3.				Sig. 4.				Sig. 5.				☽ eq. à ☉ true.
	+		Dif.		+		Dif.		±		Dif.		—		Dif.		—		Dif.		—		Dif.		
°	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	°
0	0	0			32	19			31	12			2	0			34	26			34	3			30
1	1	19	1	19	32	56	0	37	30	29	0	43	3	19	1	19	35	4	0	38	33	21	0	42	29
2	2	38	1	19	33	30	0	34	29	43	0	46	4	38	1	19	35	40	0	36	32	36	0	45	28
3	3	57	1	19	34	1	0	31	28	55	0	48	5	57	1	19	36	13	0	33	31	49	0	47	27
4	5	15	1	18	34	29	0	28	28	6	0	49	7	15	1	18	36	43	0	30	30	59	0	50	26
5	6	33	1	18	34	55	0	26	27	15	0	51	8	32	1	17	37	11	0	28	30	8	0	51	25
6	7	50	1	17	35	19	0	24	26	22	0	53	9	48	1	16	37	37	0	26	29	14	0	54	24
7	9	6	1	16	35	40	0	21	25	27	0	55	11	4	1	16	37	59	0	22	28	17	0	57	23
8	10	22	1	16	35	58	0	18	24	30	0	57	12	19	1	15	38	19	0	20	27	19	0	58	22
9	11	38	1	16	36	14	0	16	23	31	0	59	13	34	1	15	38	36	0	17	26	19	1	0	21
10	12	53	1	15	36	27	0	13	22	30	1	1	14	48	1	14	38	51	0	15	25	17	1	2	20
11	14	7	1	14	36	37	0	10	21	27	1	3	16	12	1	14	39	3	0	12	24	13	1	4	19
12	15	20	1	13	36	44	0	7	20	23	1	4	17	15	1	13	39	12	0	9	23	7	1	6	18
13	16	31	1	11	36	49	0	4	19	17	1	6	18	27	1	12	39	18	0	6	22	0	1	7	17
14	17	40	1	9	36	50	0	1	18	10	1	7	19	37	1	10	39	22	0	4	20	51	1	9	16
15	18	48	1	8	36	49	0	1	17	1	1	9	20	46	1	9	39	21	0	1	19	41	1	10	15
16	19	55	1	7	36	45	0	4	15	50	1	11	21	53	1	7	39	20	0	1	18	29	1	12	14
17	21	0	1	5	36	38	0	7	14	38	1	12	22	58	1	5	39	15	0	5	17	16	1	13	13
18	22	4	1	4	36	29	0	9	13	26	1	14	24	1	1	3	39	8	0	7	16	1	1	15	12
19	23	7	1	3	36	17	0	12	12	13	1	13	25	3	1	2	38	58	0	10	14	44	1	17	11
20	24	8	1	1	36	3	0	14	10	59	1	14	26	4	1	1	38	45	0	13	13	27	1	17	10
21	25	7	0	59	35	46	0	17	9	43	1	16	27	4	1	0	38	29	0	16	12	9	1	18	9
22	26	4	0	57	35	26	0	20	8	27	1	16	28	2	0	58	38	10	0	19	10	51	1	18	8
23	26	59	0	55	35	3	0	23	7	10	1	17	28	58	0	56	37	49	0	21	9	32	1	19	7
24	27	51	0	52	34	38	0	25	5	52	1	18	29	52	0	54	37	25	0	24	8	12	1	20	6
25	28	41	0	50	34	10	0	28	4	34	1	18	30	43	0	51	36	58	0	27	6	51	1	21	5
26	29	29	0	48	33	39	0	31	3	16	1	18	31	32	0	49	36	28	0	30	5	30	1	21	4
27	30	15	0	46	33	6	0	33	1	57	1	19	32	19	0	47	35	55	0	33	4	8	1	22	3
28	30	58	0	43	32	30	0	36	0	38	1	19	33	4	0	45	35	20	0	35	2	46	1	22	2
29	31	39	0	41	31	52	0	38	0	41	1	19	33	46	0	42	34	43	0	37	1	23	1	23	1
30	32	19	0	40	31	12	0	40	2	0	1	19	34	26	0	40	34	3	0	40	0	0	1	23	0
	—		Dif.		—		Dif.		∓		Dif.		+		Dif.		+		Dif.		+		Dif.		
☽ eq. à ☉ true.	Sig. 11.				Sig. 10.				Sig. 9.				Sig. 8.				Sig. 7.				Sig. 6.				☽ eq. à ☉ true.

For the CONSTRUCTION, see the COMMENT on the MOON's THEORY.

CORRECTION of Mean VARIATION, (See Page 73.)
By Decimal Multipliers.
To be *added* to, or *ſubtracted* from, according to its Title, the preceding *Compound Variation*.
C.

Eq. of M. Va. ☽ in Oct. or M. Dif. ⊙ to Va. in *Perig.* and *Apog.* ⊙ à ⊖. *Arg.* ☽ à ⊙. *Signs* and *Degrees.*				*Argument.* Sun's Mean ANOMALY. *Signs* and *Degrees.*						
Arg. proper.	0 / 6 +	1 / 7 +	2 / 8 +	0 ×rs	1 ×rs	2 ×rs	3 ×rs	4 ×rs	5 ×rs	Arg. proper.
°	″	″	″	Dec.	Dec.	Dec.	Dec.	Dec.	Dec.	°
0	0	107	107	,92	,80	,48	,02	,49	,86	30
1	4	109	105	,92	,80	,47	,00	,51	,87	29
2	8	111	103	,92	,79	,45	,02	,52	,88	28
3	13	112	101	,92	,78	,43	,04	,54	,89	27
4	18	114	98	,92	,77	,41	,05	,55	,89	26
5	22	116	95	,92	,76	,40	,07	,56	,90	25
6	26	117	92	,91	,75	,38	,09	,58	,91	24
7	30	119	89	,91	,74	,36	,10	,59	,91	23
8	34	120	86	,91	,73	,35	,12	,60	,92	22
9	38	121	83	,91	,72	,34	,14	,62	,92	21
10	42	122	80	,90	,71	,33	,16	,63	,93	20
11	46	123	77	,90	,70	,31	,18	,65	,94	19
12	50	123	74	,90	,69	,30	,20	,66	,95	18
13	54	124	70	,90	,68	,28	,21	,68	,95	17
14	58	124	66	,89	,67	,26	,22	,69	,96	16
15	62	124	62	,89	,66	,25	,24	,70	,96	15
16	66	124	58	,89	,65	,24	,25	,71	,97	14
17	70	124	54	,88	,64	,22	,27	,72	,97	13
18	74	123	50	,88	,63	,20	,28	,73	,97	12
19	77	123	46	,88	,62	,18	,30	,75	,98	11
20	80	122	42	,87	,61	,17	,32	,76	,98	10
21	83	121	38	,87	,60	,16	,34	,77	,99	9
22	86	120	34	,86	,59	,14	,36	,78	,99	8
23	89	119	30	,86	,58	,12	,37	,79	,99	7
24	92	117	26	,85	,57	,10	,39	,80	,99	6
25	95	116	22	,85	,55	,09	,41	,81	1,00	5
26	98	114	18	,84	,54	,07	,42	,82	1,00	4
27	101	112	14	,83	,52	,05	,43	,83	1,00	3
28	103	111	9	,82	,51	,04	,45	,84	1,00	2
29	105	109	4	,81	,50	,03	,47	,85	1,00	1
30	107	107	0	,80	,48	,02	,49	,86	1,00	0
Arg. proper.	11 + 5	10 + 4	9 + 3	×rs 11	×rs 10	×rs 9	×rs 8	×rs 7	×rs 6	Arg. proper.

Conſt. As 35′ 10″ : to 124″ :: ſo any M. Variation : to *Dif.* in *Seconds* of a Degree, to be *added* to, or *ſubtracted* from, the preſent Mean Variation, for the Variation in *Perigee* or *Apogee* ⊙, in the ſame angular Diſt. ☽ à ⊙, *reſpectively*.
As Eq. ☽ à ⊙ : to Cor. M. Var. to ⊙ An. :: ſo 1 : to ×r, *Halley*. ☽ à ⊙ 0ˢ 25° Eq. 95″, ⊙ An. 3ˢ 26° Cor. 39″, and 39″ ÷ 95″ = ,41, &c. ×r.

EXAMPLES of the USE.

THE *Maximum* of the foregoing *Equation* is the ſame as it is determined by Dr. *Halley*, the Sun being in *Perigeon*; *viz.* 2′ 4″. It *ſubtracts* from the *Mean Variation* in the *Firſt*, and *Fourth* Quadrature, of the Sun's Anomaly; and *adds* to it in the *Second* and *Third*. It is, when the Earth is in *Aphelion*, 1′ 54″, only.

The Readineſs or Facility of working by theſe Multipliers is equal, at *leaſt*, to that by the *Logiſtical Logarithms*.

EXAMPLE I.

☽ à ⊙ 10ˢ 15°. Sun's Anom. 0ˢ 0°.

	′ ″		″
Grſt. M. Var.	35 10.	Eq. of Var.	124 —
Correction	— 1 54	Dec. ×r.	,92
Preſ. Var.	33 16 . . C.		248
			1116

Comp. Var. — 36′ 49″
Correction — 114″,08 = 1 54 —
Cor. Var. — 34 55 C.

	Lo. Log.
Gr. M. Var. 35′ 10″	2320
For Sun's M. Anom.	0242. *See* P. 73.
Preſ. Var. 33′ 16″	2562 . . *Halley*.
Correction — 1 54	

EXAMPLE II. See Page 72.

☽ à ⊙ 0ˢ 25°. Sun's Anom. 3ˢ 26°.

M. Var.	26′ 56″.	Eq. Var.	95″ +
Correction	+ 40	Dec. ×r.	,42
Preſ. Variation	27 36 . . C.		190
			380

Comp. Var. + 28′ 41″
See P. 73, for *Halley*'s Mean *Variation*. *Correction* + 39″,90 = 0 40 +
Cor. V. + 29 21 C.

	Lo. Log.
M. Variation 26′ 56″	3479
For Sun's Anom.	9896 *See P.* 73.
Preſ. Variation 27 35	3375 . . *Halley*.
Correction + 0 39	

Otherwiſe. *According to the logiſtical Logarithms for correcting* Halley's *Mean Variation.*

Given:
- E′ = Minutes and Seconds in any Equation of mean Variation in Octants.
- S′ = the Sexageſimal, in *Minutes* and *Seconds*, anſwering to Lo. Log. Sun's mean Anomaly.
- e′ = the little Equation in Minutes and Seconds to be added to or ſubtracted from E, according to ☽ à ⊙, for the Variation in Perigee or Apogee, reſpectively.

e′m = Equation of *Correction*, ſought, in *Minutes* and *Seconds*, to find *m*?

By *Halley* $E' \times \frac{S'}{60'} = E' + e'm$. Hence, by Tranſpoſition and Diviſion $\frac{E' \times \frac{S'}{60'} - E'}{e'} = m$. Var. *Apog.* 33′ 16″, *Perig.* 37 14

That is, S' Dif. $60'$, $\times \frac{E'}{60' e'} = m = \frac{S' \text{Dif. } 60' \text{ in Sec}^s \text{ of a Deg.}}{213''}$ (where E′ = 35′ 10″, e′ = 2′ 4″.)

EXAMPLE. *To find the Multiplier for 2ˢ 9° Sun's Mean Anomaly?*

To which An. P. 73, Lo. Log. is 0091 | Anſwering to 58′ 45″ Dif. 60′ = 1′ 15″ = 75″ ÷ 213″ = ,35, &c. *nearly* as above.

XI. Mean REDUCTION-EQUATION of the MOON to the ECLIPTIC. C.

Arg. ☽ in Orb. à ☊ 1 eq.

☽ à ☊	0.6	1.7	2.8	☽ à ☊
°	′ ″	′ ″	′ ″	°
0	0 0	6 2	6 2	30
1	0 14	6 9	5 55	29
2	0 29	6 15	5 47	28
3	0 43	6 21	5 39	27
4	0 58	6 27	5 30	26
5	1 12	6 32	5 20	25
6	1 26	6 37	5 10	24
7	1 41	6 41	5 0	23
8	1 55	6 45	4 50	22
9	2 9	6 48	4 39	21
10	2 23	6 51	4 28	20
11	2 37	6 54	4 17	19
12	2 50	6 56	4 5	18
13	3 3	6 57	3 53	17
14	3 16	6 57	3 41	16
15	3 29	6 57	3 29	15
16	3 41	6 57	3 16	14
17	3 53	6 57	3 3	13
18	4 5	6 56	2 50	12
19	4 17	6 54	2 37	11
20	4 28	6 51	2 23	10
21	4 39	6 48	2 9	9
22	4 50	6 45	1 55	8
23	5 0	6 41	1 41	7
24	5 10	6 37	1 26	6
25	5 20	6 32	1 12	5
26	5 30	6 27	0 58	4
27	5 39	6 21	0 43	3
28	5 47	6 15	0 29	2
29	5 55	6 9	0 14	1
30	6 2	6 2	0 0	0
☽ à ☊	+	+	+	☽ à ☉
	11.5	10.4	9.3	

Note, The *Seconds* of *Reduction*, above or below the mean Reduction, are compensated for, or thrown into the Table of *Variation*, P. 50, together corresponding with the present *Inclination* of the Moon's *Orb.*

For, as many *Seconds* in the true *compound Variation* are omitted, *viz.* 24″, as *Dif.* between the *Mean*, and greatest or least *Excess* amounts to.

MOON's Mean LATITUDE. At the mean INCLINATION of her Orbit. C.

Argument. ☽ in Orb. from the Node 1 eq.

Arg. pr.	0 . N / 6 . S	Dif.	1 . N / 7 . S	Dif.	2 . N / 8 . S	Dif.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 0 0	5 22	2 34 4	4 38	4 27 2	2 40
1	0 5 22	5 23	2 38 42	4 36	4 29 42	2 34
2	0 10 45	5 22	2 43 18	4 32	4 32 16	2 30
3	0 16 7	5 22	2 47 50	4 30	4 34 46	2 24
4	0 21 29	5 22	2 52 20	4 25	4 37 10	2 19
5	0 26 51	5 21	2 56 45	4 24	4 39 29	2 14
6	0 32 12	5 20	3 1 9	4 19	4 41 43	2 9
7	0 37 32	5 20	3 5 28	4 17	4 43 52	2 4
8	0 42 52	5 19	3 9 45	4 13	4 45 56	1 59
9	0 48 11	5 18	3 13 58	4 9	4 47 55	1 54
10	0 53 29	5 17	3 18 7	4 5	4 49 49	1 47
11	0 58 46	5 17	3 22 12	4 2	4 51 36	1 43
12	1 4 3	5 15	3 26 14	3 59	4 53 19	1 38
13	1 9 18	5 14	3 30 13	3 54	4 54 57	1 32
14	1 14 32	5 12	3 34 7	3 51	4 56 29	1 27
15	1 19 44	5 11	3 37 58	3 46	4 57 56	1 20
16	1 24 55	5 9	3 41 44	3 43	4 59 16	1 16
17	1 30 4	5 7	3 45 27	3 38	5 0 32	1 10
18	1 35 12	5 6	3 49 5	3 35	5 1 42	1 4
19	1 40 18	5 4	3 52 40	3 30	5 2 46	0 59
20	1 45 22	5 3	3 56 10	3 25	5 3 45	0 54
21	1 50 25	5 0	3 59 35	3 22	5 4 39	0 48
22	1 55 25	4 58	4 2 57	3 16	5 5 27	0 42
23	2 0 23	4 56	4 6 13	3 13	5 6 9	0 36
24	2 5 19	4 54	4 9 26	3 7	5 6 45	0 31
25	2 10 13	4 51	4 12 33	3 4	5 7 16	0 26
26	2 15 4	4 49	4 15 37	2 58	5 7 42	0 20
27	2 19 53	4 46	4 18 35	2 54	5 8 2	0 14
28	2 24 39	4 44	4 21 29	2 49	5 8 16	0 8
29	2 29 23	4 41	4 24 18	2 44	5 8 24	0 4
30	2 34 4		4 27 2		5 8 28	
Arg. pr.	11 . S / 5 . N	Dif.	10 . S / 4 . N	Dif.	9 . S / 3 . N	Dif.

Ex. 1. *Arg.* Mean Lat. 9ˢ . . M. Lat. 5° 8′ 28″ S.
Arg. Equation 3ˢ . . *Equat.* — 8 52 N.

True Latitude ☽ . . 4 59 36 S.

Ex. 2. *Arg.* M. Lat. 2ˢ 10° . . M. Lat. 4° 49′ 49″ N.
Arg. Equation 5ˢ 5° . . *Equat.* + 3 44 N.

True Lat. ☽ . . 4 53 33 N.

Corresponding together with present Inclin. of ☽'s Orb.

	Signs Arg.		Signs Arg.
Note,	0. 1. 2. N. A.		6. 7. 8. S. A.
	3. 4. 5. N. D.		9. 10. 11. S. D.

N. A. North Ascending; S. A. South Ascending.
N. D. North Descending; S. D. South Descending.

EQUATION of the MOON's Mean to her *True* LATITUDE, for the present Inclin. of her Orb. C.

Arg. 2 ☽ à ☉ — forego. Ar. Lat.

0 . N / 6 . S	1 . N / 7 . S	2 . N / 8 . S	Arg. pr.
′ ″	′ ″	′ ″	°
0 0	4 25	7 40	30
0 9	4 33	7 45	29
0 18	4 41	7 49	28
0 28	4 49	7 54	27
0 37	4 57	7 58	26
0 46	5 4	8 2	25
0 55	5 12	8 6	24
1 4	5 19	8 9	23
1 14	5 27	8 13	22
1 23	5 34	8 16	21
1 32	5 41	8 20	20
1 41	5 48	8 23	19
1 50	5 55	8 26	18
1 59	6 2	8 29	17
2 8	6 9	8 31	16
2 17	6 16	8 34	15
2 26	6 22	8 36	14
2 35	6 29	8 39	13
2 44	6 34	8 41	12
2 53	6 41	8 42	11
3 1	6 47	8 44	10
3 10	6 53	8 46	9
3 19	6 59	8 47	8
3 27	7 4	8 48	7
3 35	7 10	8 49	6
3 44	7 15	8 50	5
3 52	7 21	8 51	4
4 1	7 26	8 52	3
4 9	7 31	8 52	2
4 17	7 36	8 52	1
4 25	7 40	8 52	0
11 . S / 5 . N	10 . S / 4 . N	9 . S / 3 . N	Arg. pr.

Note, The Arg. of Mean Latitude and *Argument* of Equation being *Same* / *Diff.* Name N&N, S&S / N&S, S&N the *Equation* will be + / — respectively: corresponding with the *present Inclination* of the Moon's *Orb.*

☞ Increasing and diminishing the above Eq. in *triplicate Ratio* of Sun's Dist. will be nearer, *viz.* 0′ 27″ ± at a Maximum.

Mean

Mean Horizontal PARALLAX of the MOON, in *Syzigies*.

Eccentricity 55050 to the middle State of her Orbit. Her Mean Dist fr. ⊖ being 1000000. C.

Arg. Moon's Mean Anom. 8 eq. or eq. by the 8. or M. central Equation, only.

☽'s eq. An. °	Sig. 0 + ′ ″	Sig. 1 + ′ ″	Sig. 2 + ′ ″	Sig. 3 + ′ ″	Sig. 4 + ′ ″	Sig. 5 + ′ ″	☽'s eq. An. °
0	54 10	54 35	55 44	57 18	58 52	60 1	30
1	54 10	54 37	55 47	57 22	58 54	60 2	29
2	54 10	54 38	55 50	57 25	58 57	60 4	28
3	54 10	54 40	55 53	57 28	59 0	60 5	27
4	54 10	54 42	55 56	57 32	59 2	60 6	26
5	54 11	54 44	55 59	57 35	59 5	60 7	25
6	54 11	54 46	56 2	57 38	59 8	60 9	24
7	54 11	54 48	56 5	57 41	59 10	60 10	23
8	54 12	54 50	56 8	57 44	59 13	60 11	22
9	54 12	54 52	56 11	57 47	59 16	60 13	21
10	54 12	54 54	56 14	57 51	59 18	60 14	20
11	54 13	54 56	56 17	57 54	59 20	60 15	19
12	54 14	54 58	56 20	57 57	59 23	60 16	18
13	54 14	55 1	56 23	58 0	59 25	60 17	17
14	54 15	55 3	56 27	58 3	59 28	60 18	16
15	54 16	55 5	56 30	58 6	59 31	60 19	15
16	54 17	55 7	56 33	58 9	59 33	60 19	14
17	54 18	55 10	56 36	58 12	59 35	60 20	13
18	54 19	55 12	56 39	58 15	59 38	60 21	12
19	54 20	55 15	56 42	58 19	59 40	60 21	11
20	54 21	55 17	56 46	58 22	59 42	60 22	10
21	54 22	55 19	56 49	58 25	59 41	60 22	9
22	54 23	55 22	56 52	58 28	59 46	60 23	8
23	54 24	55 25	56 56	58 31	59 48	60 23	7
24	54 25	55 27	56 59	58 34	59 50	60 24	6
25	54 27	55 30	57 3	58 37	59 52	60 24	5
26	54 28	55 33	57 6	58 40	59 54	60 24	4
27	54 30	55 36	57 9	58 43	59 56	60 25	3
28	54 32	55 39	57 12	58 46	59 57	60 25	2
29	54 34	55 41	57 15	58 49	59 59	60 25	1
30	54 35	55 44	57 18	58 52	60 1	60 25	0
☽'s eq. An.	+ Sig 11	+ Sig. 10	+ Sig. 9	+ Sig. 8	+ Sig. 7	+ Sig. 6	☽'s eq. An.

The above *Mean* Parallax, in *Syzigies*, and that in all Positions of the Moon and Sun, or in any State of the Moon's Orb, *adds* to the apparent for the true Altitude of the Moon; and consequently *subtracts* from the apparent for the true Distance from the *Vertex*, and the *contrary*.

I. Equation of ☽'s hor. Parallax. C.

Arg. Mean *Evection.*

Arg. proper °	0 / 6 + ″	1 / 7 + ″	2 / 8 + ″
0	42	36	21
1	42	35	20
2	42	35	19
3	42	35	18
4	42	34	18
5	42	34	17
6	41	34	17
7	41	33	16
8	41	33	15
9	41	33	15
10	41	32	14
11	41	32	14
12	40	31	13
13	40	31	12
14	40	31	11
15	40	30	10
16	40	30	9
17	40	29	9
18	40	29	8
19	39	28	7
20	39	27	6
21	39	26	5
22	39	25	5
23	38	25	4
24	38	24	4
25	37	24	3
26	37	23	3
27	37	23	2
28	36	22	1
29	36	22	1
30	36	21	0
Arg. proper	11 + 5	10 + 4	9 + 3

II. Equation of ☽'s hor. Parallax. C.

Arg. ☽'s true Long. à ⊙.

0 / 6 — ″	1 / 7 — ″	2 / 8 — ″	Arg. proper °
0	15	45	30
0	16	46	29
0	17	46	28
0	18	47	27
1	19	47	26
1	20	48	25
1	21	49	24
1	22	50	23
2	23	51	22
2	24	52	21
2	25	52	20
2	26	53	19
3	27	54	18
3	28	54	17
4	29	55	16
4	30	55	15
5	31	56	14
5	33	56	13
6	34	57	12
6	36	57	11
7	37	57	10
7	38	58	9
8	39	58	8
9	40	58	7
10	41	59	6
10	41	59	5
11	42	59	4
12	43	60	3
13	43	60	2
14	44	60	1
15	45	60	0
11 — 5	10 — 4	9 — 3	Arg. proper

Horizontal Parallax ☽ to her horizontal Diameter.

55′ 40″	to 30′ 0″	*La Caille.*
55 0	to 30 0	*Mayer.*
60 48	to 33 27	*Halley.*
57 20	to 31 30	*Newton.*

EXAMPLES, in and out of *Syzigies*.

EXAMPLE I.

Equated Anom. 0ˢ 0°. ☽ à ⊙ 0ˢ 0° true.

Mean H. Par. 54′ 10″ } MEv. 0ˢ 0°
Equation — 42
True H. Par. 53 28 } C.
53 29 } *Halley.*

Eq. An. 0ˢ 0° ☽ à ⊙ 3ˢ } 60′ —
M. Evection 6 } 42 +
18 —

Mean H. Par. 54′ 10″
Equation — 18
True H. Par. 53 52 } C.
53 52 } *Halley.*

EXAMPLE II.

Eq. An. 6ˢ. ☽ à ⊙ 6ˢ } 0″ —
M. Evection 6ˢ } 42″ +
Mean H. Par. 60′ 25″
Equation + 42
True H. Par. 61 7 } C.
61 7 } *Halley.*

Eq. An. 6ˢ ☽ à ⊙ 9ˢ } 1′ 0″ —
M. Evection 0ˢ } 42 —
Equation 1′ 42″ —
Mean H. Par. 60′ 25″
Equation — 1 42
True H. Par. 58 43 } C.
58 43 } *Halley.*

EXAMPLE III.

C.		*Halley.*
Eq. An. 6ˢ 0°.		Tr. An. 5ˢ 18°
		[,056 Eccen.
Mean H. Par. 60′ 25″	60′ 17	1ˢ 15°
Evec. 3ˢ 1° } + 1	+ 4	⊙ à ☽
☽ à ⊙ 4ˢ 15° } — 30	— 26	Apog.
True H. Par. 59′ 56″	59′ 55″	

EXAMPLE IV.

Eq. An. 3ˢ 1°. ☽ à ⊙ 3ˢ 0° — 1′ 0″
M. Evec. 3ˢ 7° 39′ . . . . + 0 4
Mean Hor. Parallax 57 22

True Hor. Parallax . . C. 56 26
By Halley . . 56 26

☞ We shall shew the Reduction of these Arguments of *Parallax* to *Halley*'s and *Halley*'s to these, hereafter: Or, taking + for the *proper*, and — for the *contrary* Sign,

Our/His An. ± Evec. Eq. ∓ 2ᵈ Eq. Ap. [= His/Our An.

N. B. ☽ equated Anom. — ☽ à ⊙ same eq. = An. Arg. where 1 Eq. Ap. ☽ only is concerned.
☽ Mean Anom. — 2. An. Argument = Mean Evection = 2. M. Pl. ☽ à ⊙ — ☽'s M. Anomaly.
☽ equated Anom. — An. Arg. = ☽ à ⊙; the ☽'s Pl. being the same equat. with ☽'s Anom.

EXAMPLES of Computing the True PLACES of the SUN and MOON.

C.

For the SUN's True PLACE.

Mean Time.	Sun's *Longitude.*	Sun's *Apogee.*
1733	9s 20° 58′ 18″	3s 8° 17′ 18″
May 27	4 24 53 25	. 25
Hours 20	49 17	
M. 27. S. 53	1 9	
		3 8 17 43 —
Mean Place ☉	2 16 42 9	2 16 42 9
Equation ☉ Center	+ 41 50	11 8 24 26 . . .
True Place ☉	2 17 23 59	Or ♊ 17 23 59 . . .
Equat. A. to M. Time — 1m 36s	. . . — 4	Motion correspondent.
For *app.* Time, as above	2 17 23 55	very nearly.

To find the SUN's true PLACE.

RULE. *Collect the mean* Longitudes *of the* Sun, *and his* Apogee; *subtracting the* Latter *from the* Former, *for the Sun's mean Anomaly; to which find the Equation of the Sun's Center, which connected with the Sun's mean Place, according to its proper Sign, gives his true Place, for* Mean *Time,* required. With which Place connect the Mot. equal to the Equation of A. to M. Time, for ☉'s Place, *apparent Time,* required.

Equation of apparent to *Mean* Time.

For the Sun's Mean Anomaly } + 2m 47s }
Sun's Pl. true . . } — 4 23 } By *Tab.* P. 20.

Absol. Equat. } A to M / M to A } Time ∓ 1 36 † = ∓ 3″57‴ of Deg. M. Mo.

† Or proportion the Degs by the tr. *diurn.* Mot. 57′ 14″. P. 195.

For the MOON's True PLACE.

Mean Time	Moon's *Longitude.*	Moon's *Apogee.*	Moon's *Node.*
1733	8s 1° 3′ 42″	6s 20° 25′ 24″	8s 8° 28′ 6″
May 27	4 16 55 48	16 22 37	7 47 4
Hours 20	10 58 49	5 34	2 39
M. 27. S. 53	15 18	8	4
			— 7 49 47
Mean Place ☽	0 29 13 37	7 6 53 43	8 0 38 19
Annual Equat. I.	— 4 4	+ 9 23	— 3 22
☽ 1 Equated	0 29 9 33	7 7 3 6	—8 0 34 57
Apogee —	7 7 3 6	Moon's *Apogee,* 1 eq.	0 26 19 42
☽ Mean Anomaly	5 22 6 27	5 22 6 27	4 25 44 45
6 less Equations	+ 0 22	2 20 41 46 . . .	2 ☉ à ☽'s Apogee.
☽ Anom. 7 Equated	5 22 6 49	3 1 24 41 . . .	Mean Evection.
Elliptic Equation VIII.	— 0 55 42	— 0 27 29 . . .	½ El. Eq. & 6 less Eqns.
☽ Anom. 8 Equated	5 21 11 7	3 0 57 12	IX. Arg. of *Evection.*
Evection Equation IX.	— 1 20 26		
☽ Anom. 9 Equated	5 19 50 41	For *Corr.* of M. Variat. } Arg. ☉ M. An. L.L.0226.P.73.	
Comp. Var. Equation X. — 35′ 54″, *corrected*	— 34 9	Cor.—1′45″; Eq.122″, × r,86	
☽ true Equated Anom.	5 19 16 32	By *Tab.* Page 53. { Mean H. Par. 60′ 22″	
Apog. 1 Equated +	7 7 3 6	M. Evec. Eq. + 0 1	
		☽ tr. à ☉ Eq. — 0 37	
☽ *Orbit* Longitude	0 26 19 38	True Hor. Par. 59 46	
Reduction + 20″ XI. Equat. Precess. P. 33.	+ 6 49	By (P. 78) *Halley* 59 47	
☽ in Ecliptic	♈ 26 26 27	☽ Anom. 9 Equated Arg.	
Observed	♈ 26 26 16	— ☉ à ☽'s Ap. or Ann.	
Error	+ 0 11	☽ à ☉ . .	
	— 8 20 *Halley's Tables.*		

No.	Arguments of *Equations.* s ° ′	*Equations.* — ′ ″	+ ′ ″
II.	7 10 21	5 13	. . .
III.	6 16 50	26	. . .
IV.	4 5 2	. . .	0 49
V.	2 16 7	. . .	1 22
VI.	2 9 48	. . .	2 16
VII.	3 23 0	. . .	1 34
uated Arg.	5 19 51	5 39	6 1
	7 10 21		5 39
X.	10 9 30	+	0 22

To find the MOON's true PLACE.

RULE. *Collect the mean Longitudes of the Moon, her Apogee, and Node, and then connect the Equations, from the several Arguments, as on the Left, and below.*

☞ *The* ☽'s *Ap.* 1 *eq.* is first subt. *from* ☽'s *Place* 1 *eq. for finding the M. Anom. eq. Anomalies, and Arguments, and is* lastly *added to* ☽'s *Pl.* 10 *eq. for her Orbit Place.*

☊.
☽ Orb Long. ☽'s Lat.
XI. ☽ in Orb à ☊. I. Arg. Lat. } 2° 53′ 26
2 ☽ à ☉ — I. Ar. II. Arg. Lat. } Eq. + 8 9
☽'s true Lat. N. D. 3 1 35

Horizontal Parallax ☽ to ☽'s horizontal Diam. 60′ 48″ to 33′ 27″, Or 60′ to 33′.

Arguments.

☉	2s 17° 23′ 59″
— ☽'s Ap.	7 7 3 6
☉ à ☽ Ap. or Argument *Annual.*	7 10 20 53
Double	2 20 41 46
2 ☽ à ☉	8s 19° 0′
— I. Arg. M. La.	4 25 45
II. Arg. Eq. Lat.	3 23 15
6 less Equations.	

N. B. The ☽'s *observed Longitude* above is corrected by + 14″, according to the Precept in the Preface to Dr. *Halley's Astronomical Tables*; being the Dif. of the app. above and true Semi-Diameter of the Moon, in Long. or R. A. at any Time, with Respect to ☽'s Alt. and Lat. or Declination: Dr. *Halley* having deduced his *lunar Places,* in observing either Limb of the ☽, from her *app.* instead of her *true* Diam. at those Times:

Sun's Longitude to Mean Time above 2s 17° 23′ 59″
Equation of *Precession,* Page 33. . . . + 20
Sun's corrected Place : : 2 17 24 19

60′48″ to 33′27″ is as 60′ to 33′, for the horizontal Parallax to the hor. Diam. of the Moon, being as 1 to ,55. Hence the constant Log. Log. 2596 being added to the Log. Log. of the hor. Par. will give the Lo. Log. of the Moon's hor. Diam. Or ½, + 1/10 of that Half, of the horizontal Parallax = horizontal Diameter of the Moon.

EXAMPLE.		Lo. Log.
Moon's horizontal Parallax	59′ 46″ +	0017 2596
Moon's horizontal Diameter	32′ 52″	2613

Or, ☽'s hor. Par. 59′ 46″ = 59′,76
,55 × r.
½ . . 29 53
1/10 . . 2 59
32′,868
52″
☽'s hor. Diam. 32′ 52″ as before.

☞ *For common Use, where great Exactness in the Moon's Place is not required, the 6 less Equations,* II, III, IV, V, VI, *and* VII, *may be omitted, as amounting but to few Minutes; in the* present Instance *but to* + 22″. *And the* I, VIII, IX, X, *and* XI *Equations (the last being the Reduction-Equation at a Mean) will be sufficient.*

REMARKS

REMARKS on Mr. *MAYER*'s ACCELERATION of the MOON's MOTION.

Mr. MAYER having faid, that by comparing feveral *Periods of Eclipfes* together he is afcertained of the Moon's Motion being *quicker* now than in former Ages; and that in 60 Years it is 1′ 9″ fafter than *Halley*'s or *our* Tables reprefent it. I had therefore a Mind to try, whether from folar Eclipfes (whofe Beginning and End are much more accurately determined than *lunar* Ones; and which, if central, or nearly fo, the Error of a *Minute* in Latitude will not make any fenfible Error in the Scruples of Incidence) I could collect any *Acceleration* beyond what the prefent Tables reprefent.

For this *Purpofe*, I took one *Period* of 54 Years and *another* of 72: The *firft* from 1661 to 1715; the other from 1676 to 1748.

	Equal Time at *Greenwich*.
March 10, 1661, *Hevelius* obferved the End of the *folar* Eclipfe at *Dantzic* . .	11h 16m 11s
Moon's Longitude obferved . .	♈ 11° 4′ 9″
Error of Computation . .	+ 5
April 15, 1715, Dr. *Halley* obferved the Beginning of the total *folar* Eclipfe . .	8h 2m 40s
Moon's Longitude obferved . .	♉ 11° 20′ 17″
54 Years Diftance. *Error* of Computation . .	— 2″
June 1, 1676, *Hevelius* obferved the End of a *folar* Eclipfe	10h 23m 30s
Moon's Longitude obferved . .	♊ 21° 26′ 17″
Error of Computation . .	— 4″
July 14, 1748, Dr. *Bradley* obferved, at *Greenwich*, the End of a *folar* Eclipfe . .	12h 15m 48s
Moon's Longitude obferved . .	♌ 3° 9′ 37″
72 Years Diftance. *Error* of Computation . .	+ 11″

According to *Mayer's Hypothefis* our Tables fhould have loft in 54 Years . .	1′ 2″
But by the foregoing Computation the *Difference* is only . .	— 7″
According to the fame *Hypothefis* in 72 Years, our Tables fhould have *loft* . .	1′ 23″
But, by Comparifon of the Computation, they have *gained* . .	15″

☞ Confidering the *Diftance* of Time, between *Hevelius*'s Days and Ours, and the great Difference of the Meridians, the near Agreement in Computation, as well as Nearnefs of Obfervation, is furprizing, after fuch a long Period of Time!

I am fenfible that thefe Obfervations are too *few* to fpeak with Certainty upon; but they give one *Reafon* to hope that the *Mean Motions* in this Age do not much differ from thofe fet down *in our Tables*: though the Acceleration of the Moon's Motion, for former Ages, appears more evident, as we have fhewn, and allowed for, further on. D. C.

An ACCOUNT of the foregoing TABLES.

THE *Radical* Mean PLACES of the SUN and MOON, (diftinguifhed from Mean MOTIONS) are fitted to the Beginning of each *Julian* Year, in the *Old* or *New* Style, as expreffed, anfwerable to *December* 31, at Noon: Except thofe Radical Mean Places for the *Leap-Years*, which are advanced by a Day's Motion, anfwerable to the 1ft Day of *January* at Noon; and on which Account 1 Day and a Day's Motion is to be fubducted in the Computation for Leap-Years, or 1 Day lefs taken out for, in the Months of *January* and *February*, as being the fhorter Method; inftead of adding a Day and Day's Motion for all the Months after *February*, according to the old Method in all former aftronomical Tables.

The mean or middle Motions, in refpect of Time (diftinguifhed from the radical mean or middle Places) are every where proportional to the Differences of the radical mean Places, in *Revolutions, Signs, Degrees, &c.* for different Points of Time.

The *radical* mean Places and Motions for both *Old* and *New* Styles are inferted to fuit the Purpofes of Computation for Time back (before the New Style) as well as for Time *forward*, fince the Account of Time by the New Style, was eftablifhed. By this Means the Computer *firft* reducing the Date of one Style to the other, may make a double Computation correfponding to either Style, and thereby find the Agreement in the Refult of both Methods, when great *Certainty* or *Accuracy* is required: Or finding a Difagreement of both Methods, he may proceed to *detect his Error*, and difcover Truth in the End.

The 99 *Julian* Years Motion, fuited to both Styles, and never before contrived, ferve for *adding* to or *fubtracting* from the radical mean Places of the SUN or MOON; according as the Time for the mean Places fought is forward or backward, *refpectively*, of the Time for the given *Radixes*; being the *fhorteft Method* of Computation that can be put in Practice, efpecially with the Motions for each Month-Day, as we have annexed to it; there being only one Addition or Subtraction of two Lines, and then one Addition of another Line to find the mean Place of the SUN or MOON, for any Day at Noon; whatever may be the Number of Years backward or forward of the prefent Year.

But we have given the *Radixes* from 1652 to 1752, O. S. when the Style received Alteration by Act of Parliament, and alfo from 1752 to 1852, N. S. for determining the radical mean Places of the *Sun* or *Moon*, for any Day at Noon, in any Year Old or New Style, of thofe Intervals, by one Addition of *two* Lines, only.

We have alfo given the *radical mean Places* of the *Sun* and *Moon*, at the Beginning of every *Month*, or End of the former Month, (except giving them for *January* 1, and *February* 1, at Noon, in Leap-Years) in the Years 1600, 1700, and 1800, O. and N. Style, by which the mean Places of Sun and Moon are had, for any Day at Noon, in any Year of thofe Centuries, by the Addition of three Lines; namely the Radix-Line, Line of the Year's Motion, and Line of the Day's Motion, in that Year; whereby the Refult of one Computation may be proved by the other, correfponding with the Dates of the different Styles.

The *Motions* of the *Sun* and *Moon* are alfo given to the Beginning of each *Month* in the Year to be *added* to the *Radixes*, anfwering to the Beginning of any Year, Old or New Style, and to which the Motion for the Number of the Month-Day is to be added, for the Sake of *Variety*, and antient Cuftom.

And EXAMPLES of the USE and PRACTICE, of all thefe *different Methods* of Computation, are exhibited at the Bottom, or on the Sides of the Pages at the Beginning of our Work, to make them *clear*, and undoubted.

There are different *Methods* and *Tables*, for proportioning the Difference of Equations: So that the Computer may take his Choice of that Method which fuits him beft. This is a *new Improvement* we have made which was much wanted, to facilitate Computation, and give Eafe to the Attention. We find, by Experience, that fince *Sexagefimals* may be reduced, at Sight, into Decimals, *(fee P.* 14.) that multiplying the *Difference* of Equation, by the *Difference* of Argument (reduced to Decimals) finds the *proportional* Difference to be added to or fubtracted from the *firft Equation*, about as foon as the *Logiftical Logarithm* of one of them can be found (turning over Leaves) and greatly eafes Attention, beyond any other Method. But, for thofe who are not expert or ready at Multiplication, they may ufe the *Tables* at Pages 256, 257, 258, and 259, with great Facility and Quicknefs.

Our *Table*, at Page 13, is a *Novelty*, firft thought of; but proportions not fo quick as thofe juft mentioned.

[illegible] *The* [illegible] *of the* folar *and* lunar *Places and Motions are fitted to* Mean *Time*; *to which* Apparent *Time muft be always reduced, in* [illegible] to Ufe *by* [illegible] *Tables.*

PRECEPTS.

PRECEPTS OF COMPUTATION.

Precept I. *To reduce the Apparent to equal* Time *and the contrary?*

By *Tab.* p. 19. Take out the Equation, at once, standing under A, correspondent to the Sun's *true Place*, and according to its Sign, + or —, add or subtract it, to or from the apparent for the Mean Time. Or if the *Mean Time* is given, take out the Equation standing under M, correspondent to the Sun's *true Place*, and according to its Sign, + or —, *add* or *subtract* it, to or from the Mean for the Apparent Time, required: being the *Converse* of the former Equation for reducing Apparent to Mean Time.

Otherwise. By *Tab. p.* 20, take out the *first Equation* correspondent to the *Sun's Place*, under A, or M, according as either the *Apparent* or *Mean* Time is given, to be reduced to the Time required, and set it down with its proper Sign, + or —; then take out the *second Equation* of Time answerable to the *Sun's M. Anomaly*, under A or M, correspondent to the Apparent or Mean Time given, in the *first* Equation, to be reduced to the required Time, and set this 2d Equat. down with its proper *Sign*, under the *1st Equation*; these two Equations connected together in a Sum or Difference with the proper Sign prefix'd thereto, (adding the Equations together, if of *like Signs*, and putting the *Sign* of either to the *Sum*; or if of unlike Signs taking their *Difference*, and putting the Sign of the *greater* Equation to that Difference) will be the *Absolute Equation* of Time required, to be added to or subtracted from the *Time given*, according as its Sign is + or —, for reducing it to the *Time required.*

Prec. II. *To compute the true* Place *of the* Sun?

Among the *Radixes* of the Mean Places, seek the *Radix* to the Year in which the Sun's true Place is required, (*if of modern Date*) and set down the Sun's Mean Place and Apogee, in distinct Columns for the *Beginning* of that Year; then *add* the Mean Motion of the *Sun* and his *Apogee*, for the *Month, Day, Hour, Minute* and *Second* in that Year, the Sum of which will be the Sun's Mean *Place* and *Apogee* to the Mean *Time required.*

Or, if the Year is far back, or forward of the present Date, set down the M. Places for any of the Centuries you will find in p. 8, and afterwards set down under them the Mean Motion of the Sun and his Apogee for the Years since, and under those the Motions for the *Day, Hour, &c.* since those; the Sum of which (rejecting Revolutions) will be the Mean Place of the *Sun*, and of his *Apogee* for the Mean *Time required.*

Or, if you can find the *Century*, in the *Month*-Page 10, take out the Mean Places to the Year and Beginning of the *Month*, then subjoin the Motions for the *Year, Day, Hour, &c.* since that Century; and the Sum of which will be the Mean Place of the *Sun* and his *Apogee*, required. *See Exam.* p. 10 and 11.

NOW, from the Sun's Mean Place or Long. deduct the Place of his Apogee, and the *Remainder* will be the Sun's *Mean Anomaly*; with which (*from Table p.* 12.) take out the Equation of the *Sun's Center* (by making proper Proportion for the *Diff.* of Equation and *Diff.* of Argument) adding or subtracting it, to or from the Sun's *Mean Place*, according to the Sign of Equation + or —, and the *Result* will be the Sun's true Longitude, for the Mean Time, required. *See Example* p. 54. You may correct his true Place, thus computed, by *Table of Precession*, p. 33.

Prec. III. To *compute the Mean and then the true* Place *of the* Moon.

FROM among the *Radixes* of the Moon, as of the Sun, set down the *Mean* Place of the *Moon*, her *Apogee* and *Node*, in distinct Columns, drawing a *Line* under the radical Mean Place of the *Node*. Then set down in each of these respective Columns, the Mean Motions of the *Moon, Apogee*, and *Node*, for Time since the radical Time and Places. Collect the Mean Longitude or Place of the Moon, and her *Apogee* into two distinct Sums, in like Manner as the Mean Longitude and *Apogee* of the Sun is collected, by the foregoing *Precept*. But the Mean Motion of the *Node* being retrograde, you must collect the Motions of the *Node* into one Sum, since the first radical Time and Place, and subtract that Sum from the Node's radical Mean Place, under which a Line was drawn, and the *Residue* will be the present Mean Place of the Node; as the Sum of the radical Mean Places and Motions of the *Moon* and *Apogee*, before collected, will be the Mean Places of the *Moon* and *Apogee* for the Mean *Time* required.

Prec. IV. *To apply the Moon's* EQUATIONS *to her Mean* PLACES, *to find her true* Place.

1. FROM p. 44. (Having computed the ☉'s true Place to the Mean Time for which the ☽'s true Place is required) take out I. *Equation* of ☽, Apogee, and ☊, according to the Argument of ☉'s M. Anom. and set down their respective Quantities and Signs, under their *like* in the Mean Motions, which added and subtracted, as required, the *Result* will be the Moon's Place, Apogee, and Node, 1 equated.

2. Deduct the ☽'s *Apogee* 1 equated, from ☽'s Place 1 equated, and the ☽'s Anomaly 1 equated will remain: with which *connecting* the 6 less Equations, taken from their several and respective Arguments, the *Result* will be the Moon's Anomaly 7. equated.

3. With the Argument of the Moon's *Anomaly 7. equated* take out (*from p.* 48) the Mean *Central Equation*, which (with its proper Sign) *connect* with the ☽'s Anom. 7. equated, and you will have the Moon's Anomaly 8 equated.

4. From the ☽'s *Anom.* 1 *equated* deduct 2 ☉ à ☽'s Apogee, or twice Ann. Argt. and the Remainder will be the *Mean Evection*; with which M. Evection *connect* (with the proper *Sign*) ½ Sum of the Mean Ecliptic or central Equation, and 6 less Equation, II, III, IV, V, VI, VII, and the *Result* will be the *Argt. of Evection*, for reducing the Mean to the true Central Equation. With which Argt. of *Evection*, take out (*fr. p.* 49) the *Evection* Equation, and *connect* it (in its proper Sign) with ☽'s *Anom.* 8 equated, and you will have ☽'s *Anom.* 9 *equated.*

5. From the Moon's Anomaly 9 *equated*, deduct ☉ à ☽'s Apogee, or annual Argument, and the *Remainder* will be the ☽ à ☉, or Arg. of X. *Equation*; with which (*fr. P.* 50) take out the *compound Variation-Equation*, and correct it, according to *Halley*'s Correction of M. Variation, P. 73, or by decimal ×rs, Page 51, connect which now *correct Variation* with its proper Sign, and ☽'s *Anomaly* 9 *equated*, and you will have ☽'s *Anomaly* 10 *equated*. To which adding the ☽'s Apogee 1 equated, (before deducted from ☽'s Place 1 equated) and you will have the ☽'s *Orbit-Place*, or Longitnde in her *Orbit.*

6. From the Moon's *Orbit-Place*, deduct the Place of the *Node* 1 equated, and the *Remainder* will be the ☽ à ☊, or the Arg. for the *Reduction* of her *Orbit-Place* to the Ecliptic; and also the *Argument* for finding her mean *Latitude*. With which *Argument* take out the *Reduction-Equation* (from Page 51) and connect it (in the proper Sign) with the ☽'s Orbit-Place, (connecting also the Equation of *Precession* from Page 33, at the same Time, or at last, if you like it best) and you will have the Moon's *true Place in the Ecliptic, required.*

Prec. V. *To find the* MOON'*s true* LATITUDE?

With the Argument of *Reduction*, or of the mean Latitude, before found, take out (*from Page* 52) the Moon's mean Latitude. Then deduct this *Arg.* from *twice* the Moon from the Sun, and the *Remainder* will be the *Arg.* of *Equation* of Latitude. With which *Arg.* take out the Equation of Latitude from the same Page, adding or subtracting it, to or from the *mean Latitude* before found, (according as it is of the *same* or *different* Name with the mean Latitude) and the *Result* will be the *true Latitude* of the Moon, required.

Prec. VI. *To find the* MOON'*s true Horizontal* PARALLAX?

WITH the Argument of the Moon's mean Anomaly, corrected with the *Mean central* Equation, or Anom. 8 equated, take out (*from P.* 53) the mean horizontal *Parallax* correspondent to the middle State of the Moon's Orbit; then, with the Argument of *mean Evection*, take out the first Equation of ☽'s horizontal Parallax; and *lastly*, with the Argument of ☽ à ☉ *true*, (or Residue of the *annual* Argument from the ☽'s *Anom.* 9 *equated*) take out the *second Equation* of the Moon's horizontal Parallax, connecting these two Equations, in their proper Signs, with the mean horizontal Parallax, and the *Result* will be the true horizontal *Parallax* (agreeing with *Halley*'s prolixer Method) required. See EXAMPLES, Pages 53 and 54.

Prec. VII. *To find the* MOON'*s true horizontal* DIAMETER?

ADD the const. Lo. Log. 2596 to the Lo. Log. of the true horiz. Parallax, and their Sum will be the Lo. Log. of true horizontal Diam.

Otherwise. Take the Half of the true horizontal Parallax, then take the *Tenth* of that *Half*, and the Sum of both will be the true horizontal Diameter of the Moon, required. Or multiply the horizontal Parallax by ,55 for the horizontal Diameter of the Moon.

☞ The true horizontal *Parallax*, according to *Mayer*, differs from the horizontal Parallax determined by this and also *Halley*'s Method, by almost Half a *Minute* of a Degree.

Prec. VIII. *To find the* Moon'*s apparent* Diameter *from her true horizontal* Diameter?

By *Tab.* 2, *P.* 263, add the Seconds, answering to the Moon's Distance from her Apogee, and according to her Altitude, to the horizontal Diameter, and the Sum will be the apparent Diameter in Altitude, required.

Prec. IX. *To find the* Moon'*s true and also apparent* Diameter *in* Longitude *and* Right Ascension?

As Cos. ☽'s Latitude or Declination : is to Rad. :: { so is ☽'s horizontal Diameter : to her true Diameter } in Long. or R.A. *respectively.*
{ . . . app. Diam. in Altitude : app. Diameter . . . }

See Tab. 1, *P.* 263, for Equation of true to apparent Diameter in Longitude and right Ascension, respectively, according to ☽'s Lat. or Decl.

The Supplemental or Auxiliary Tables following are for different Methods of Computation.

SUPPLEMENTAL

SUPPLEMENTAL SOLAR EQUATIONS:

For determining the SUN's true Place from the mean, according to different *Radixes*, and *Hypotheses* of the Earth's Orbit.

EQUATION of the SUN's CENTER, according to *Eccentricity* of the *Earth's Orbit* 1692, and mean Distance à Sun, 100000.

Argument. SUN's Mean ANOMALY.

⊙ M. An.	Sig. 0 —	Dif.	Sig. 1 —	Dif.	Sig. 2 —	Dif.	Sig. 3 —	Dif.	Sig. 4 —	Dif.	Sig. 5 —	Dif.	⊙ M. An.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	1 59	0 57 7	1 44	1 39 41	1 1	1 56 19	0 1	1 41 48	1 0	0 59 15	1 49	30
1	0 1 59	2 0	0 58 51	1 42	1 40 42	0 59	1 56 20	0 1	1 40 48	1 2	0 57 26	1 49	29
2	0 3 59	1 59	1 0 33	1 42	1 41 41	0 58	1 56 19	0 3	1 39 46	1 5	0 55 37	1 49	28
3	0 5 58	1 59	1 2 15	1 40	1 42 39	0 56	1 56 16	0 4	1 38 41	1 6	0 53 48	1 51	27
4	0 7 57	1 59	1 3 55	1 40	1 43 35	0 54	1 56 12	0 7	1 37 35	1 8	0 51 57	1 52	26
5	0 9 56	1 59	1 5 35	1 39	1 44 29	0 52	1 56 5	0 9	1 36 27	1 10	0 50 5	1 52	25
6	0 11 55	1 58	1 7 14	1 37	1 45 21	0 50	1 55 56	0 11	1 35 17	1 12	0 48 13	1 54	24
7	0 13 53	1 58	1 8 51	1 36	1 46 11	0 49	1 55 45	0 14	1 34 5	1 13	0 46 19	1 54	23
8	0 15 51	1 58	1 10 27	1 34	1 47 0	0 46	1 55 31	0 16	1 32 52	1 15	0 44 25	1 55	22
9	0 17 49	1 58	1 12 1	1 34	1 47 46	0 45	1 55 15	0 17	1 31 37	1 17	0 42 30	1 56	21
10	0 19 47	1 58	1 13 35	1 32	1 48 31	0 42	1 54 58	0 20	1 30 20	1 19	0 40 34	1 57	20
11	0 21 45	1 57	1 15 7	1 31	1 49 13	0 40	1 54 38	0 22	1 29 1	1 20	0 38 37	1 57	19
12	0 23 42	1 56	1 16 38	1 29	1 49 53	0 39	1 54 16	0 24	1 27 41	1 22	0 36 40	1 59	18
13	0 25 38	1 57	1 18 7	1 29	1 50 32	0 37	1 53 52	0 26	1 26 19	1 24	0 34 41	1 59	17
14	0 27 35	1 55	1 19 36	1 27	1 51 9	0 35	1 53 26	0 28	1 24 55	1 25	0 32 42	1 59	16
15	0 29 30	1 55	1 21 3	1 25	1 51 44	0 33	1 52 58	0 31	1 23 30	1 27	0 30 43	2 0	15
16	0 31 25	1 55	1 22 28	1 23	1 52 17	0 31	1 52 27	0 32	1 22 3	1 28	0 28 43	2 1	14
17	0 33 20	1 54	1 23 51	1 23	1 52 48	0 28	1 51 55	0 35	1 20 35	1 30	0 26 42	2 1	13
18	0 35 14	1 54	1 25 14	1 21	1 53 16	0 27	1 51 20	0 39	1 19 5	1 32	0 24 41	2 2	12
19	0 37 8	1 53	1 26 35	1 20	1 53 43	0 24	1 50 44	0 39	1 17 33	1 33	0 22 39	2 2	11
20	0 39 1	1 52	1 27 55	1 18	1 54 7	0 23	1 50 5	0 41	1 16 0	1 34	0 20 37	2 3	10
21	0 40 53	1 51	1 29 13	1 16	1 54 30	0 20	1 49 24	0 42	1 14 26	1 36	0 18 34	2 3	9
22	0 42 44	1 51	1 30 29	1 14	1 54 50	0 19	1 48 42	0 45	1 12 50	1 37	0 16 31	2 3	8
23	0 44 35	1 50	1 31 43	1 13	1 55 9	0 16	1 47 57	0 46	1 11 13	1 39	0 14 28	2 4	7
24	0 46 25	1 49	1 32 56	1 12	1 55 25	0 14	1 47 11	0 49	1 9 34	1 40	0 12 24	2 3	6
25	0 48 14	1 48	1 34 8	1 10	1 55 39	0 12	1 46 22	0 51	1 7 54	1 41	0 10 21	2 4	5
26	0 50 2	1 48	1 35 18	1 8	1 55 51	0 10	1 45 31	0 53	1 6 13	1 42	0 8 17	2 4	4
27	0 51 50	1 46	1 36 26	1 7	1 56 1	0 8	1 44 38	0 55	1 4 31	1 44	0 6 13	2 4	3
28	0 53 36	1 46	1 37 33	1 5	1 56 9	0 6	1 43 43	0 56	1 2 47	1 45	0 4 9	2 5	2
29	0 55 22	1 45	1 38 38	1 3	1 56 15	0 4	1 42 47	0 59	1 1 2	1 47	0 2 4	2 4	1
30	0 57 7		1 39 41		1 56 19		1 41 48		0 59 15		0 0 0		0
⊙ M. An.	+ Sig. 11	Dif.	+ Sig. 10	Dif.	+ Sig. 9	Dif.	+ Sig. 8	Dif.	+ Sig. 7	Dif.	+ Sig. 6	Dif.	⊙ M. An.

THE above *Equation* is according to the *Newtonian Hypothesis* of the Earth's Orbit, and the *Hallcian* Computation.

To compute the Sun's Place for the Meridian of Greenwich Observatory *from our* Tables, *according to any other* Tables, *correspondent to our mean Motions, and the above Hypothesis of the Earth's Orbit?*

RULE. Note the Difference + — in a Table between the given *Radixes* of Sun's Place and Apogee for any *common or Leap Year*, and our *Radixes* (reduced to the Meridian of *Greenwich*) for the same Year, and connect the same Differences with the mean Places of our Tables for any Time required; and then work with the *above Equation Table* as with any other, for the proper Mean Anomaly of the Sun.

	⊙	Apogee	According to	
EXAMPLE. Connect with Mean Places	— 3″	. . 0′ 0″	*Newton,*	Then use the Equation above.
	— 10	— 5 10	*Halley,*	
	+ 10	+ 2 0	*Morris,*	

SUPPLEMENTAL SOLAR TABLES.

LOGARITHMS of the SUN's foregoing proportional *Distances* from the EARTH, to the mean Distance 100000. And *Eccentricity* of the *Earth's* Orbit, 1692.

Argument. SUN's Mean ANOMALY.

⊙ M. An.	Sig. 0. Logar.	Dif.	Sig. 1 Logar.	Dif.	Sig. 2 Logar.	Dif.	Sig. 3 Logar.	Dif.	Sig. 4 Logar.	Dif.	Sig. 5 Logar.	Dif.	⊙ M. An.
°													°
0	5,007286	1	5,006347	63	5,003749	109	5,000124	129	4,996405	113	4,993620	65	30
1	5,007285	3	5,006284	64	5,003640	109	4,999995	128	4,996292	112	4,993555	64	29
2	5,007282	5	5,006220	66	5,003531	111	4,999867	128	4,996180	111	4,993491	62	28
3	5,007277	8	5,006154	67	5,003420	113	4,999739	128	4,996069	110	4,993429	60	27
4	5,007269	9	5,006087	69	5,003307	113	4,999611	128	4,995959	109	4,993369	58	26
5	5,007260	11	5,006018	72	5,003194	114	4,999483	128	4,995850	108	4,993311	56	25
6	5,007249	14	5,005946	74	5,003080	115	4,999355	128	4,995742	106	4,993255	54	24
7	5,007235	17	5,005872	75	5,002965	116	4,999227	128	4,995636	105	4,993201	51	23
8	5,007218	18	5,005797	77	5,002849	117	4,999099	128	4,995531	104	4,993150	48	22
9	5,007200	20	5,005720	78	5,002732	118	4,998971	127	4,995427	102	4,993102	47	21
10	5,007180	22	5,005642	80	5,002614	119	4,998844	127	4,995325	101	4,993055	46	20
11	5,007158	24	5,005562	82	5,002495	120	4,998717	127	4,995224	98	4,993009	43	19
12	5,007134	27	5,005480	83	5,002375	120	4,998590	127	4,995126	98	4,992966	40	18
13	5,007107	28	5,005397	85	5,002255	121	4,998463	127	4,995028	96	4,992926	38	17
14	5,007079	31	5,005312	87	5,002134	122	4,998336	126	4,994932	96	4,992888	36	16
15	5,007048	33	5,005225	89	5,002012	122	4,998210	126	4,994836	93	4,992852	34	15
16	5,007015	35	5,005136	89	5,001890	123	4,998084	124	4,994743	91	4,992818	32	14
17	5,006980	37	5,005047	91	5,001767	124	4,997960	123	4,994652	90	4,992786	29	13
18	5,006943	38	5,004956	93	5,001643	125	4,997837	123	4,994562	88	4,992757	26	12
19	5,006905	41	5,004863	95	5,001518	125	4,997714	123	4,994474	87	4,992731	25	11
20	5,006864	43	5,004768	96	5,001393	125	4,997591	123	4,994387	85	4,992706	23	10
21	5,006821	45	5,004672	97	5,001268	126	4,997468	121	4,994302	83	4,992683	20	9
22	5,006776	46	5,004575	98	5,001142	126	4,997347	121	4,994219	81	4,992663	17	8
23	5,006730	49	5,004477	100	5,001016	127	4,997226	120	4,994138	80	4,992646	15	7
24	5,006681	51	5,004377	102	5,000889	127	4,997106	119	4,994058	78	4,992631	13	6
25	5,006630	53	5,004275	102	5,000762	127	4,996987	119	4,993980	76	4,992618	11	5
26	5,006577	55	5,004173	104	5,000635	127	4,996868	118	4,993904	73	4,992607	8	4
27	5,006522	56	5,004069	106	5,000508	128	4,996750	116	4,993831	72	4,992599	6	3
28	5,006466	58	5,003963	106	5,000380	128	4,996634	115	4,993759	71	4,992593	3	2
29	5,006408	61	5,003857	108	5,000252	128	4,996519	114	4,993688	68	4,992590	1	1
30	5,006347		5,003749		5,000124		4,996405		4,993620		4,992589		0
° ⊙ M. An.	Logar. Sig. 11	Dif.	Logar. Sig. 10	Dif.	Logar. Sig. 9	Dif.	Logar. Sig. 8	Dif.	Logar. Sig. 7.	Dif.	Logar. Sig. 6	Dif.	° ⊙ M An

The above TABLE is according to the *Newtonian Hypothesis* of the Earth's Orbit, and *Halleian* Computation. By which, and any other TABLE, for a different Eccentricity of the Earth's Orbit, the Logarithms of the *Proportional Distances*, or Distances themselves, may be determined for any third TABLE, to the same Degrees of the Sun's mean Anomaly, and other Eccentricity, different from the two former *Eccentricities*.

	Log*s*.	Eccen*s*.	Prop. Dis*t*.
EXAMPLE. 1*s* 20° Sun M. An.	5,004768	1692	101104
	5,004734	1680	101096
$\frac{1}{2}, + \frac{1}{6}$ of $\frac{1}{2} = -$	34	12	8
	— 20	— 7	— 4
Answer	5,004748	1685	101100

To find for 1685 *Eccentricity, or* 7 *of* 12 *less? Or* $\frac{1}{2}, + \frac{1}{6}$ *of* $\frac{1}{2}$ *of Differences taken from first Quantity.*

N. B. The Logarithms must be taken to 7 Places, to be correspondent in the 6th Place.

SUPPLEMENTAL

SUPPLEMENTAL SOLAR TABLES.

EQUATION of the SUN's CENTER, according to Eccentricity of the Earth's Orbit, 1680, and Mean Distance of the SUN from the Earth 100000.

Argument. SUN's Mean ANOMALY.

☉ M. An.	Sig. 0	Dif.	Sig. 1	Dif.	Sig. 2	Dif.	Sig. 3	Dif.	Sig. 4	Dif.	Sig. 5	Dif.	☉ M. An.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	1 59	0 56 43	1 42	1 38 58	1 1	1 55 29	0 1	1 41 4	1 0	0 58 49	1 47	30
1	0 1 59	1 59	0 58 25	1 41	1 39 59	0 59	1 55 30	0 1	1 40 4	1 4	0 57 2	1 48	29
2	0 3 58	1 58	1 0 6	1 41	1 40 58	0 57	1 55 29	0 3	1 39 2	1 4	0 55 14	1 49	28
3	0 5 56	1 58	1 1 47	1 40	1 41 55	0 55	1 55 26	0 2	1 37 58	1 6	0 53 25	1 50	27
4	0 7 54	1 58	1 3 27	1 39	1 42 50	0 54	1 55 21	0 6	1 36 52	1 7	0 51 35	1 50	26
5	0 9 52	1 58	1 5 6	1 38	1 43 44	0 52	1 55 15	0 9	1 35 45	1 10	0 49 45	1 51	25
6	0 11 50	1 58	1 6 44	1 37	1 44 36	0 50	1 55 6	0 11	1 34 35	1 11	0 47 54	1 52	24
7	0 13 48	1 57	1 8 21	1 36	1 45 26	0 48	1 54 55	0 13	1 33 24	1 13	0 46 2	1 53	23
8	0 15 45	1 57	1 9 57	1 34	1 46 14	0 46	1 54 42	0 16	1 32 11	1 15	0 44 9	1 55	22
9	0 17 42	1 57	1 11 31	1 33	1 47 0	0 44	1 54 26	0 18	1 30 56	1 16	0 42 14	1 56	21
10	0 19 39	1 57	1 13 4	1 32	1 47 44	0 42	1 54 8	0 20	1 29 40	1 18	0 40 18	1 56	20
11	0 21 36	1 56	1 14 36	1 30	1 48 26	0 40	1 53 48	0 22	1 28 22	1 20	0 38 22	1 57	19
12	0 23 32	1 56	1 16 6	1 29	1 49 6	0 38	1 53 26	0 24	1 27 2	1 21	0 36 25	1 57	18
13	0 25 28	1 55	1 17 35	1 27	1 49 44	0 36	1 53 2	0 26	1 25 41	1 23	0 34 28	1 58	17
14	0 27 23	1 55	1 19 2	1 26	1 50 20	0 35	1 52 36	0 27	1 24 18	1 25	0 32 30	1 59	16
15	0 29 18	1 54	1 20 28	1 25	1 50 55	0 33	1 52 9	0 30	1 22 53	1 26	0 30 31	1 59	15
16	0 31 12	1 54	1 21 53	1 23	1 51 28	0 31	1 51 39	0 32	1 21 27	1 28	0 28 32	2 0	14
17	0 33 6	1 53	1 23 16	1 22	1 51 59	0 29	1 51 7	0 34	1 19 59	1 29	0 26 32	2 0	13
18	0 34 59	1 53	1 24 38	1 20	1 52 28	0 27	1 50 33	0 36	1 18 30	1 31	0 24 32	2 1	12
19	0 36 52	1 52	1 25 58	1 19	1 52 55	0 24	1 49 57	0 39	1 16 59	1 32	0 22 31	2 2	11
20	0 38 44	1 51	1 27 17	1 17	1 53 19	0 22	1 49 18	0 41	1 15 27	1 34	0 20 29	2 2	10
21	0 40 35	1 51	1 28 34	1 15	1 53 41	0 20	1 48 37	0 43	1 13 53	1 35	0 18 27	2 2	9
22	0 42 26	1 50	1 29 50	1 14	1 54 1	0 18	1 47 54	0 44	1 12 18	1 37	0 16 25	2 2	8
23	0 44 16	1 49	1 31 4	1 13	1 54 19	0 16	1 47 10	0 46	1 10 41	1 38	0 14 23	2 3	7
24	0 46 5	1 49	1 32 17	1 11	1 54 35	0 15	1 46 24	0 48	1 9 3	1 39	0 12 20	2 3	6
25	0 47 54	1 48	1 33 28	1 9	1 54 50	0 12	1 45 36	0 50	1 7 24	1 40	0 10 17	2 3	5
26	0 49 42	1 47	1 34 37	1 8	1 55 2	0 10	1 44 46	0 52	1 5 44	1 42	0 8 14	2 3	4
27	0 51 29	1 46	1 35 45	1 6	1 55 12	0 8	1 43 54	0 54	1 4 2	1 43	0 6 11	2 3	3
28	0 53 15	1 45	1 36 51	1 4	1 55 20	0 6	1 43 0	0 57	1 2 19	1 44	0 4 8	2 4	2
29	0 55 0	1 43	1 37 55	1 3	1 55 26	0 3	1 42 3	0 59	1 0 35	1 46	0 2 4	2 4	1
30	0 56 43		1 38 58		1 55 29		1 41 4		0 58 49		0 0 0		0
°	+		+		+		+		+		+		°
☉ M. An.	Sig. 11	Dif.	Sig. 10	Dif.	Sig. 9	Dif.	Sig. 8	Dif.	Sig. 7	Dif.	Sig. 6	Dif.	☉ M. An.

THE above *Equation* is according to the *Parisian Hypothesis* of the Earth's Orbit, and Computation of the Celebrated *Tobias Mayer*, of *Gottingen*, in *Germany*.

The Sun's Place for the Meridian of Greenwich Observatory, *according to Mr.* Mayer's Tables, is computed from our Tables, by adding 15″ to Mean Place Sun, and 1′ to M. Place of *Apogee* Sun, by our Tables, and then using the *above Equation*, correspondent to the proper M. Anomaly Sun.

	☉ *Place.*	☉ *Apogee.*
N. B. Mr. *Mayer's Radixes* for *Paris* 1701, ...	9ˢ 20° 43′ 35″	3ˢ 7° 45′ 30″
Reduce to the Merid. of *Greenwich* . . 9ᵐ 20ˢ W. Motion	+ 23	
Mayer's Correspondent *Radix* at *Greenwich* . . .	9 20 43 58	
Our *Radixes* 1701 . . .	9 20 43 43	9 7 44 30
Our *Radixes* reduce to *Mayer's* by	+ 15	+ 1 0 Difference.

SUPPLEMENTAL SOLAR TABLES.

SUN's PROPORTIONAL DISTANCES from the EARTH, according to the foregoing Eccentricity 1680, and mean Distance 100000.

Argument. SUN's mean ANOMALY.

☉ M. An. °	Sig. 0 ☉ à ⊖	Dif.	Sig. 1 ☉ à ⊖	Dif.	Sig. 2 ☉ à ⊖	Dif.	Sig. 3 ☉ à ⊖	Dif.	Sig. 4 ☉ à ⊖	Dif.	Sig. 5 ☉ à ⊖	Dif.	☉ M. An. °
0	101680	0	101462	14	100861	25	100028	30	99182	26	98553	15	30
1	101680	1	101448	15	100836	25	99998	30	99156	25	98538	14	29
2	101679	1	101433	15	100811	26	99968	29	99131	25	98524	14	28
3	101678	2	101418	16	100785	26	99939	29	99106	25	98510	14	27
4	101676	2	101402	17	100759	26	99910	29	99081	25	98496	13	26
5	101674	3	101385	17	100733	26	99881	29	99056	25	98483	13	25
6	101671	3	101368	17	100707	27	99852	29	99031	24	98470	12	24
7	101668	4	101351	17	100680	27	99823	29	99007	24	98458	12	23
8	101664	4	101334	18	100653	27	99794	29	99983	23	98446	11	22
9	101660	5	101316	18	100626	27	99765	29	98960	23	98435	10	21
10	101655	5	101298	18	100599	27	99736	29	98937	23	98425	10	20
11	101650	6	101280	19	100572	27	99707	29	98914	22	98415	10	19
12	101644	6	101261	19	100545	28	99678	29	98892	22	98405	9	18
13	101638	7	101242	20	100517	28	99649	29	99870	22	98396	9	17
14	101631	7	101222	20	100489	28	99620	29	99848	21	98387	8	16
15	101624	7	101202	20	100461	28	99591	28	98827	21	98379	8	15
16	101617	8	101182	21	100433	28	99563	28	98806	21	98371	7	14
17	101609	8	101161	21	100405	28	99535	28	98785	20	98364	6	13
18	101601	9	101140	22	100377	29	99507	28	98765	20	98358	6	12
19	101592	10	101118	22	100348	29	99479	28	98745	20	98352	5	11
20	101582	10	101096	22	100319	29	99451	28	98725	19	98347	5	10
21	101572	11	101074	23	100290	29	99423	28	98706	19	98342	4	9
22	101561	11	101051	23	100261	29	99495	27	98687	18	98338	4	8
23	101550	11	101028	23	100232	29	99468	27	98669	18	98334	4	7
24	101539	12	101005	23	100203	29	99441	27	98651	17	98330	3	6
25	101527	12	100982	23	100174	29	99314	27	98634	17	98327	3	5
26	101515	13	100959	24	100145	29	99287	27	98617	17	98324	2	4
27	101502	13	100935	24	100116	29	99260	26	98600	16	98322	1	3
28	101489	13	100911	25	100087	29	99234	26	98584	16	98321	1	2
29	101476	14	100886	25	100058	30	99208	26	98568	15	98320	0	1
30	101462		100861		100028		99182		98553		98320		0
° ☉ M. An.	☉ à ⊖ Sig. 11	Dif.	☉ à ⊖ Sig. 10	Dif.	☉ à ⊖ Sig. 9	Dif.	☉ à ⊖ Sig. 8	Dif.	☉ à ⊖ Sig. 7	Dif.	☉ à ⊖ Sig. 6	Dif.	° ☉ M. An.

THE above TABLE is according to the *Parisian Hypothesis*, of the Earth's *Orbit*, and the Celebrated *Mayer*'s Computation.

	Equations,	Ecc^s.		Greatest Equ^n	☉ M. An.
☉ M. An. $1^s\ 15^\circ$	$1^\circ\ 21'\ 3''$	1692	*Halley*	$1^\circ\ 56'\ 20''$	$3^s\ 1^\circ$
	1 20 28	1680	*Mayer*	1 55 30	
$\frac{1}{2}$, + $\frac{1}{6}$ of $\frac{1}{2}$ Diff^s =	— 35 — 21	12 — 7		50 —29	Dif. from 1st Quantities.
Equation ☉ Center	1 20 42	1685	*Our Tables.*	1 55 5	

N. B. Tables are otherwise depressed or elevated in Proportion to the Differences of their respective Maxima, *or greatest Quantities, similar to the Rule of different Eccentricities.*

Thus are all the necessary Uses of the foregoing *Supplemental Solar Tables* explained.

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES:

For determining the True from the MOON's Mean PLACE, according to different METHODS and THEORIES.

I. EQUATION of the MOON, APOGEE and NODE.

Argument. SUN's Mean ANOMALY.

⊙ M. An.	Sig. 0 ☽ +	Dif.	Sig. 0 Ap. −	Dif.	Sig. 0 ☊ +	Dif.	Sig. 1 ☽ +	Dif.	Sig. 1 Ap. −	Dif.	Sig. 1 ☊ +	Dif.	Sig. 2 ☽ +	Dif.	Sig. 2 Ap. −	Dif.	Sig. 2 ☊ +	Dif.	⊙ M. An.
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
0	0 0	12	0 0	20	0 0	9	5 47	11	9 49	18	4 40	8	10 7	7	17 8	11	8 9	5	30
1	0 12	12	0 20	21	0 9	10	5 58	11	10 7	17	4 48	9	10 14	6	17 19	10	8 14	5	29
2	0 24	12	0 41	20	0 19	10	6 9	10	10 24	18	4 57	8	10 20	6	17 29	10	8 19	5	28
3	0 36	12	1 1	21	0 29	10	6 19	10	10 42	17	5 5	8	10 26	5	17 39	9	8 24	4	27
4	0 48	12	1 22	20	0 39	9	6 29	10	10 59	17	5 13	8	10 31	6	17 48	10	8 28	4	26
5	1 0	12	1 42	21	0 48	10	6 39	10	11 16	17	5 21	8	10 37	5	17 58	9	8 32	4	25
6	1 12	12	2 3	20	0 58	10	6 49	10	11 33	16	5 29	8	10 42	5	18 7	9	8 36	4	24
7	1 24	12	2 23	20	1 8	10	6 59	10	11 49	17	5 37	8	10 47	5	18 16	8	8 40	4	23
8	1 36	12	2 43	21	1 18	9	7 9	10	12 6	16	5 45	8	10 52	4	18 24	8	8 44	4	22
9	1 48	11	3 4	20	1 27	10	7 19	9	12 22	17	5 53	7	10 56	5	18 32	7	8 48	4	21
10	1 59	12	3 24	20	1 37	9	7 28	10	12 39	16	6 0	8	11 1	4	18 39	7	8 52	3	20
11	2 11	12	3 44	20	1 46	10	7 38	8	12 55	15	6 8	7	11 5	4	18 46	7	8 55	3	19
12	2 23	12	4 4	20	1 56	9	7 46	9	13 10	16	6 15	7	11 9	5	18 53	7	8 58	4	18
13	2 35	11	4 24	20	2 5	10	7 55	9	13 26	15	6 22	8	11 14	5	19 0	6	9 2	3	17
14	2 46	12	4 44	20	2 15	9	8 4	9	13 41	15	6 30	7	11 19	3	19 6	6	9 5	2	16
15	2 58	12	5 4	20	2 24	10	8 13	9	13 56	14	6 37	7	11 22	3	19 12	6	9 7	3	15
16	3 10	12	5 24	20	2 34	9	8 22	9	14 10	15	6 44	6	11 25	3	19 18	5	9 10	2	14
17	3 22	12	5 44	19	2 43	10	8 31	8	14 25	14	6 50	7	11 28	2	19 23	5	9 12	3	13
18	3 34	12	6 3	20	2 53	9	8 39	8	14 39	14	6 57	7	11 30	2	19 28	5	9 15	2	12
19	3 46	11	6 23	20	3 2	9	8 47	8	14 53	14	7 4	7	11 32	3	19 33	4	9 17	2	11
20	3 57	12	6 43	19	3 11	9	8 55	8	15 7	14	7 11	6	11 35	3	19 37	4	9 19	2	10
21	4 9	11	7 2	19	3 20	9	9 3	8	15 21	12	7 17	6	11 38	2	19 41	3	9 21	1	9
22	4 20	11	7 21	19	3 29	9	9 11	8	15 33	13	7 23	6	11 40	2	19 44	4	9 22	2	8
23	4 31	11	7 40	19	3 38	9	9 19	8	15 46	12	7 29	6	11 42	1	19 48	3	9 24	1	7
24	4 42	11	7 59	19	3 47	9	9 27	7	15 58	13	7 35	6	11 43	2	19 51	2	9 25	1	6
25	4 53	11	8 18	18	3 56	9	9 34	7	16 11	12	7 41	5	11 45	1	19 53	2	9 26	1	5
26	5 4	11	8 36	18	4 5	9	9 41	6	16 23	12	7 46	6	11 46	1	19 55	2	9 27	1	4
27	5 15	11	8 54	19	4 14	9	9 47	7	16 35	11	7 52	6	11 47	1	19 57	1	9 28	1	3
28	5 26	11	9 13	18	4 23	8	9 54	7	16 46	11	7 58	6	11 48	0	19 58	1	9 29	0	2
29	5 37	10	9 31	18	4 31	9	10 1	6	16 57	11	8 4	5	11 48	1	19 59	1	9 29	1	1
30	5 47		9 49		4 40		10 7		17 8		8 9		11 49		20 0		9 30		0
⊙ M. An.	− ☽ Sig. 11	Dif.	+ Ap. Sig. 11	Dif.	− ☊ Sig. 11	Dif.	− ☽ Sig. 10	Dif.	+ Ap. Sig. 10	Dif.	− ☊ Sig. 10	Dif.	− ☽ Sig. 9	Dif.	+ Ap. Sig. 9	Dif.	− ☊ Sig. 9	Dif.	⊙ M. An.

THE above *Equations* are according to the *Newtonian* Theory, and *Halleian* Computation. See *Schol. Prop.* 35. *B.* 3. *Principia*, Last Edit. p. 299.

Sir ISAAC NEWTON finds the greatest Equation ☽ from the *Theory* of Gravity, 11′ 49″; but thinks, as the Earth's Eccentricity is something greater than he supposed (16⅞ to 1000, Rad. or Mean Dist. ⊙ à ⊖) *viz.* $16\frac{11}{12}$ Eccentricity, the greatest Equation will be about 11′ 51″.

He found that the Apogee and Nodes moved faster in *Perih.* (where the Force of ⊙'s Action is greater) than in Aphel.—That this Motion of the Ap. and Node is in the *reciprocal triplicate Proportion* of ⊖'s Dist. from ⊙. That the greatest Equation ⊙ Center, generated by ⊙'s Motion, in reciprocal *duplicate* Proportion ⊙ à ⊖, is 1° 56′ 20″, correspondent to Eccentricity ⊖'s Orbit $16\frac{11}{12}$ aforesaid, which would be 2° 54′ 30″ by a reciprocal *triplicate Proportion* of Distance of the Sun à Earth. And therefore the greatest Equations generated by the ☽'s Ap.

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES.

I. EQUATION of the MOON, APOGEE and NODE.

Argument. SUN's Mean ANOMALY.

☉ M. An.	Sig. 3						Sig. 4						Sig. 5						☉ M. An.
	☽ +	Dif.	Ap. −	Dif.	☊ +	Dif.	☽ +	Dif.	Ap. −	Dif.	☊ +	Dif.	☽ +	Dif.	Ap. −	Dif.	☊ +	Dif.	
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
0	11 49	0	20 0	0	9 30	0	10 21	6	17 30	10	8 19	5	6 0	11	10 11	19	4 50	9	30
1	11 49	0	20 0	0	9 30	0	10 15	8	17 20	11	8 14	5	5 49	11	9 52	19	4 41	9	29
2	11 49	1	20 0	1	9 30	0	10 7	6	17 9	11	8 9	5	5 38	11	9 33	18	4 32	9	28
3	11 48	0	19 59	0	9 30	1	10 1	6	16 58	12	8 4	6	5 27	11	9 15	19	4 23	9	27
4	11 48	1	19 58	1	9 29	0	9 55	8	16 46	12	7 58	5	5 16	11	8 56	19	4 14	9	26
5	11 47	0	19 57	1	9 29	1	9 47	7	16 34	11	7 53	5	5 5	12	8 37	20	4 5	9	25
6	11 47	2	19 56	2	9 28	1	9 40	7	16 23	12	7 48	6	4 53	11	8 17	10	3 56	9	24
7	11 45	1	19 54	3	9 27	1	9 33	7	16 11	13	7 42	7	4 42	12	7 58	20	3 47	9	23
8	11 44	2	19 51	2	9 26	1	9 26	7	15 58	13	7 35	6	4 30	12	7 38	20	3 38	9	22
9	11 42	1	19 49	3	9 25	1	9 19	8	15 45	13	7 29	6	4 18	12	7 18	20	3 29	10	21
10	11 41	2	19 46	4	9 24	2	9 11	9	15 32	14	7 23	7	4 6	12	6 58	20	3 19	10	20
11	11 39	3	19 42	4	9 22	2	9 2	8	15 18	14	7 16	7	3 54	11	6 38	20	3 9	10	19
12	11 36	2	19 38	4	9 20	2	8 54	8	15 4	14	7 9	6	3 43	12	6 18	20	3 59	9	18
13	11 34	3	19 34	4	9 18	2	8 46	9	14 50	14	7 3	7	3 31	12	5 58	20	2 50	10	17
14	11 31	2	19 30	5	9 16	2	8 37	9	14 36	15	6 56	7	3 19	12	5 38	21	2 40	10	16
15	11 29	4	19 25	5	9 14	2	8 28	8	14 21	15	6 49	7	3 7	13	5 17	21	2 30	10	15
16	11 25	3	19 20	6	9 12	3	8 20	9	14 6	15	6 42	7	2 54	12	4 56	21	2 20	10	14
17	11 22	3	19 14	6	9 9	3	8 11	10	13 51	16	6 35	8	2 42	12	4 35	21	2 10	10	13
18	11 19	4	19 8	6	9 6	3	8 1	9	13 35	15	6 27	7	2 30	12	4 14	20	2 0	10	12
19	11 15	4	19 2	7	9 3	4	7 52	9	13 20	16	6 20	8	2 18	13	3 54	21	1 50	10	11
20	11 11	5	18 55	7	8 59	3	7 43	9	13 4	16	6 12	8	2 5	13	3 33	21	1 40	10	10
21	11 6	4	18 48	7	8 56	4	7 34	10	12 48	17	6 4	8	1 52	12	3 12	21	1 30	10	9
22	11 2	4	18 41	8	8 52	4	7 24	10	12 31	16	5 56	7	1 40	12	2 51	21	1 20	10	8
23	10 58	5	18 33	8	8 48	3	7 14	11	12 15	17	5 49	8	1 28	13	2 30	22	1 10	10	7
24	10 53	5	18 25	8	8 45	4	7 3	10	11 58	17	5 41	8	1 15	13	2 8	22	1 0	10	6
25	10 48	5	18 17	9	8 41	4	6 53	10	11 41	18	5 33	9	1 2	13	1 46	21	0 50	10	5
26	10 43	5	18 8	9	8 37	4	6 43	10	11 23	18	5 24	8	0 49	12	1 25	21	0 40	10	4
27	10 38	6	17 59	9	8 33	5	6 33	11	11 5	18	5 16	8	0 37	12	1 4	21	0 30	10	3
28	10 32	6	17 50	10	8 28	5	6 22	11	10 47	18	5 8	9	0 25	13	0 43	22	0 20	10	2
29	10 26	5	17 40	10	8 23	4	6 11	11	10 29	18	4 59	9	0 12	12	0 21	21	0 10	10	1
30	10 21		17 30		8 19		6 0		10 11		4 50		0 0		0 0		0 0		0
☉ M. An.	− ☽	Dif.	+ Ap.	Dif.	− ☊	Dif.	− ☽	Dif.	+ Ap.	Dif.	− ☊	Dif.	− ☽	Dif.	+ Ap.	Dif.	− ☊	Dif.	☉ M. An.
	Sig. 8						Sig. 7						Sig. 6						

☽'s Ap. and ☊, are to 2° 54′ 30″, as the M. *diurnal* Mot. ☽'s Apog. and of her ☊ respectively are to M. diurnal Mot. ☉. — Hence gr. Equation ☽'s Apogee comes out 19′ 43″. And gr. Eq. of Moon's ☊s 9′ 24″; which Dr. *Halley* raised to 20′ and 9′ 30″: But D. *Cowper* fixed the gr. Equations ☽, Ap. and ☊, at 11′ 25″; 25′ 45″; and 9′ 24″, *respectively*, as has been shewn, for correcting the Mean *Evection*-Eqn. or Mean *Difference* between the Mean and True *Central Equation*. Hence arise annual Equations of these *three Motions*, directly proportional to the Equations of ☉'s Center, as before shewn.

					Decimals.	Log. Log.	Lo. Log.		
As 1° 56′ 20″ ☉ gr. Eq.	: S. Sun's Present Equation	::	11′ 49″	:	S×,1016 =	Eq. ☽ =	0.9932	± Log.L.L.S. under / above	60′.
			20 0′		S×,1719 =	Eq. Ap. =	0.7646		
			9 30		S×,0817 =	Eq. ☊ =	1.0879		

SUPPLEMENTAL LUNAR TABLES.

II. EQUATION of the MOON: ☉ in Apogee and Perigee.

1. Semiannual.

Arg. SUN from MOON's Apogee.

☉ à ☽ ap.	Sig. 0 6 (' '')	G.D abo. L.eq (")	Sig. 1 7 (' '')	G.D abo. L.eq (")	Sig. 2 8 (' '')	G.D abo. L.eq (")	☉ à ☽ ap.
°	—		—		—		°
0	0 0	0	3 5	19	3 5	19	30
1	0 7	1	3 9	19	3 1	19	29
2	0 15	1	3 12	20	2 57	18	28
3	0 22	2	3 15	20	2 53	18	27
4	0 30	3	3 18	20	2 49	17	26
5	0 37	4	3 21	21	2 44	17	25
6	0 45	4	3 24	21	2 39	16	24
7	0 52	5	3 26	21	2 34	16	23
8	0 59	6	3 28	21	2 29	15	22
9	1 6	7	3 29	21	2 23	15	21
10	1 13	8	3 31	22	2 18	14	20
11	1 20	8	3 32	22	2 12	14	19
12	1 27	9	3 33	22	2 6	13	18
13	1 34	10	3 33	22	2 0	12	17
14	1 40	10	3 34	22	1 53	12	16
15	1 47	11	3 34	22	1 47	11	15
16	1 53	12	3 34	22	1 40	10	14
17	2 0	12	3 33	22	1 34	10	13
18	2 6	13	3 33	22	1 27	9	12
19	2 12	14	3 32	22	1 20	8	11
20	2 18	14	3 31	22	1 13	8	10
21	2 23	15	3 29	21	1 6	7	9
22	2 29	15	3 28	21	0 59	6	8
23	2 34	16	3 26	21	0 52	5	7
24	2 39	16	3 24	21	0 45	4	6
25	2 44	17	3 21	21	0 37	4	5
26	2 49	17	3 18	20	0 30	3	4
27	2 53	18	3 15	20	0 22	2	3
28	2 57	18	3 12	20	0 15	1	2
29	3 1	19	3 9	19	0 7	1	1
30	3 5	19	3 5	19	0 0	0	0
☉ à ☽ ap.	+ 11 5 Sig.	G.D abo. L.eq	+ 10 4 Sig.	G.D abo. L.eq	+ 9 3 Sig.	G.D abo. L.eq	☉ à ☽ ap.

Construction. Where ☽ Ap. is without the *Octants* of Sun, as above, *As Rad. : S. doub. Dist. Sun à ☽ Ap. (i.e. fr. nearest Quadrature or Syzygy) :: S. greatest Eq. : S. pres. Eq. i. e.* Rad. : S. 3′ 34″ :: S. double Sun à ☽ Ap. : S. *Pres.* Eq.— USE. As 3′ 34″, gr. Eq. in *Octants* Sun in Ap. : Least Eq. : as above, Sun in Ap. :: Gr. Eq. in Oct[s] correspondt Sun M. An. : Pres. *true* Equation. Or, As 3′ 34″ : G. Æ :: P. Æ. : $\frac{G.Æ. \times P.Æ.}{3' 34''}$ = *True* Eq. Hence, the *Construction* of L. Logs. correspondent to Sun M. An. in Equa. of ☽ in Octants.

Ex. *To find the Pres. Equat.* ☽, *for Sun à* ☽ *Ap.* 0[s] 27°, *and* 2[s] 5° *Sun M. Anomaly?*

	L.Eq.	G.D.	
Sun à ☽ Ap. 0[s] 27° .	2′ 53″ .	18″	ab. L. Eq.
	+ 5	,31 ×[r]	for 2[s] 5°
Present Equation	2′ 58″ red	18	[SunM.An.
		54	
		+ 5″,58	

DECIMAL MULTIPLIERS to the *Gr. Dif.* above the *Least Equat.* for Sec[s]. to be added thereto, for the present Equation ☽.

Arg. SUN's Mean Anom.

☉ M A.	0 ×rs	1 ×rs	2 ×rs	3 ×rs	4 ×rs	5 ×rs	☉ M A.
°							°
0	,00	,07	,27	,5	,77	,95	30
1	,00	,07	,28	,51	,78	,96	29
2	,00	,08	,29	,52	,79	,96	28
3	,01	,08	,30	,52	,79	,96	27
4	,01	,08	,30	,53	,80	,97	26
5	,01	,09	,31	,54	,81	,97	25
6	,01	,09	,32	,55	,82	,97	24
7	,01	,11	,33	,55	,82	,97	23
8	,02	,11	,33	,56	,83	,98	22
9	,02	,11	,34	,57	,83	,98	21
10	,02	,12	,35	,58	,83	,98	20
11	,02	,13	,36	,58	,84	,98	19
12	,02	,14	,36	,59	,84	,99	18
13	,03	,14	,37	,60	,84	,99	17
14	,03	,15	,38	,61	,85	,99	16
15	,03	,16	,39	,61	,85	,99	15
16	,03	,17	40	,62	,86	1.	14
17	,03	,17	,40	,63	,86	1.	13
18	,03	,18	,41	,64	,86	1.	12
19	,04	,19	,42	,65	,87	1.	11
20	,04	,20	,42	,66	,88	1.	10
21	,04	,20	,43	,67	,89	1.	9
22	,04	,21	,44	,68	,89	1.	8
23	,04	,22	,45	,69	,90	1.	7
24	,05	,23	,46	,71	,91	1.	6
25	,05	,24	,46	,72	,92	1.	5
26	,05	,24	,47	,73	,92	1.	4
27	,06	,25	,48	,74	,93	1.	3
28	,06	,26	,49	,75	,94	1.	2
29	,07	,27	,49	,76	,95	1.	1
30	,07	,27	,5	,77	,95	1.	0
☉ M A.	×rs 11	×rs 10	×rs 9	×rs 8	×rs 7	×rs 6	☉ M A.

Construction. As 22″ greatest Dif. of Equation in *Octants*, ☉ in Apogee and Perigee : present Dif. Eqn betn ☉ in Ap. and according to M. An. Sun :: greatest Dif. of Equation, Sun in *Apogee*, according to Argument : present *Dif.* to be added to the Equation of the Argument.

Ex. *Let Sun M. An.* 4[s] *where the present Dif. Equation from Least* = 17″ Then 22″ : 17″ :: G. D. : ,77 × G.D. Proportional Equation required.

Greatest Equat. ☽ being in *Octants* of *Sun.*

Arg. Sun's M. An.

☉ M. An. (s °)	Gr. Equ. (' '')	Lo. Log.	Sun M. An. (° s)
0 0	3 34	0	0 12
6	3 34	0	24
12	3 34	0	18
18	3 34	0	12
24	3 35	20	6
1 0	3 35	20	0 11
6	3 36	41	24
12	3 37	61	18
18	3 37	61	12
24	3 38	81	6
2 0	3 39	100	0 10
6	3 40	120	24
12	3 41	140	18
18	3 42	160	12
24	3 44	198	6
3 0	3 45	218	0 9
6	3 46	237	24
12	3 47	256	18
18	3 48	275	12
24	3 50	313	6
4 0	3 51	332	0 8
6	3 52	351	24
12	3 53	370	18
18	3 54	388	12
24	3 54	388	6
5 0	3 55	407	0 7
6	3 56	425	24
12	3 56	425	18
18	3 56	425	12
24	3 56	425	6
6 0	3 56	425	0 6
☉ M. An.	Gr. Eq.	— Lo. Log.	Sun M. An.

Construction. The above *Æquation* of 3′ 34″ in Ap. Sun and 3′ 56″ in Perig. Sun, increases or diminishes in the inverse *Ratio* of the 3d Power of the Sun à ☊, *i. e.* in the reciprocal triplicate Proportion. *See Schol.* Prop. 35. B. 3. P. 300. *Princip.*

EXAMPLE *of the foregoing Case.*

′ ″	L. Log.
2 53 Equation.	1,3183
For 2[s] 5° A. Sun	— 120
2′ 58″ Eq. reqd.	1,3063

correct, as before.

III. EQUATION of the MOON. Sun at M. Dist. from Earth.

2. Sem-annual.

Arg. Sun from Node.

☉ à ☊	Sig. 0 6 (' '')	Sig. 1 7 (' '')	Sig. 2 8 (' '')	☉ à ☊
°	—	—	—	°
0	0 0	0 41	0 41	30
1	0 2	0 41	0 40	29
2	0 3	0 42	0 39	28
3	0 5	0 43	0 38	27
4	0 7	0 44	0 37	26
5	0 8	0 44	0 36	25
6	0 10	0 45	0 35	24
7	0 11	0 45	0 34	23
8	0 13	0 46	0 33	22
9	0 15	0 46	0 31	21
10	0 16	0 46	0 30	20
11	0 18	0 47	0 29	19
12	0 19	0 47	0 28	18
13	0 21	0 47	0 26	17
14	0 22	0 47	0 25	16
15	0 24	0 47	0 24	15
16	0 25	0 47	0 22	14
17	0 26	0 47	0 21	13
18	0 28	0 47	0 19	12
19	0 29	0 47	0 18	11
20	0 30	0 46	0 16	10
21	0 31	0 46	0 15	9
22	0 33	0 46	0 13	8
23	0 34	0 45	0 11	7
24	0 35	0 45	0 10	6
25	0 36	0 44	0 8	5
26	0 37	0 44	0 7	4
27	0 38	0 43	0 5	3
28	0 39	0 42	0 3	2
29	0 40	0 41	0 2	1
30	0 41	0 41	0 0	0
☉ à ☊	+ 11 5 Sig.	+ 10 4 Sig.	+ 9 3 Sig.	☉ à ☊

Construction. As Rad. S. 47″ a *Maxim.* :: S. doub. Sun à ☊ : S. *Present* Equn.

In *other* Distances of Sun à ☊, this Equation, *greatest* in the *Octants* of the Nodes, is reciprocally as Cube Sun à ☊. And in *Perigee* is 49″ and in Apogee 45″.

N. B. The above Equation, and the former two of the Supplemental are accorf to the *Newtonian Theory.*

SUPPLEMENTAL LUNAR TABLES.

SECOND EQUATION of the MOON's APOGEE, from the *Newtonian* THEORY: With *Decimal* and *Sexagesimal* MULTIPLIERS into the *Greatest Diff.* under or above the *Mean Central* EQUATION of the MOON, for directly finding the Present correct *Diff.* from the *Mean*, and thence the whole Central EQUATION of the MOON. According to our NEW METHOD of Computing.

Argument. SUN from the MOON's APOGEE, or Sun's True Place — Moon's Apogee 1 Equated.

⊙ à ☽ ap.	Sig. 0. 6.						Sig. 1. 7.						Sig. 2. 8.						⊙ à ☽ ap.
°	2d Equ. ☽ Apo. + ° ′ ″	Dif. ′ ″	X^rs for C.Eq. above	D.	Sex^l X for c.e above ′ ″	D. ′ ″	2d Equa. ☽ Apog. + ° ′ ″	Dif. ′ ″	X^rs for C.Eq. above	D.	Se^l X^s for c.e above ′ ″	D. ′ ″	2d Equa. ☽ Apo. + ° ′ ″	Dif. ′ ″	X^rs for C.Eq. under	D.	Se^l X^s for c.e under ′ ″	D. ′ ″	°
0	0 0 0	21 5	1.	6	60 0	0 2	9 28 8	14 15	,5718	273	34 18	1 38	11 40 16	9 21	,4114	325	24 41	1 58	30
1	0 21 5	21 4	,9994	15	59 58	0 6	9 42 23	13 46	,5445	280	32 40	1 41	11 30 55	10 26	,4443	325	26 39	1 57	29
2	0 42 9	21 2	,9979	24	59 52	0 8	9 56 9	13 16	,5165	285	30 59	1 42	11 20 29	11 30	,4768	320	28 36	1 56	28
3	1 3 11	21 0	,9955	36	59 44	0 13	10 9 25	12 44	,4880	293	29 17	1 46	11 8 59	12 36	,5088	313	30 32	1 52	27
4	1 24 11	20 56	,9919	45	59 31	0 16	10 22 9	12 12	,4587	297	27 31	1 47	10 56 23	13 42	,5401	308	32 24	1 51	26
5	1 45 7	20 52	,9874	55	59 15	0 20	10 34 21	11 38	,4290	304	25 44	1 49	10 42 41	14 47	,5709	301	34 15	1 49	25
6	2 5 59	20 47	,9819	65	58 55	0 24	10 45 59	11 3	,3986	308	23 55	1 51	10 27 54	15 54	,6010	294	36 4	1 45	24
7	2 26 46	20 42	,9754	75	58 31	0 27	10 57 2	10 26	,3678	314	22 4	1 53	10 12 0	16 58	,6304	286	37 49	1 43	23
8	2 47 28	20 35	,9679	84	58 4	0 30	11 7 28	9 49	,3364	318	20 11	1 54	9 55 2	18 4	,6590	278	39 32	1 40	22
9	3 8 3	20 27	,9595	95	57 34	0 34	11 17 17	9 10	,3046	323	18 17	1 57	9 36 58	19 8	,6868	269	41 12	1 37	21
10	3 28 39	20 19	,9500	104	57 0	0 37	11 26 27	8 30	,2723	327	16 20	1 57	9 17 50	20 12	,7137	260	42 49	1 34	20
11	3 48 49	20 10	,9396	113	56 23	0 41	11 34 57	7 48	,2396	331	14 23	2 0	8 57 38	21 14	,7397	250	44 23	1 30	19
12	4 8 59	20 0	,9283	124	55 42	0 45	11 42 45	7 6	,2065	334	12 23	2 0	8 36 24	22 16	,7647	240	45 53	1 26	18
13	4 28 59	19 48	,9159	133	54 57	0 48	11 49 51	6 21	,1731	337	10 23	2 1	8 14 8	23 15	,7887	229	47 19	1 23	17
14	4 48 47	19 37	,9026	142	54 9	0 51	11 56 12	5 36	,1394	340	8 22	2 3	7 50 53	24 13	,8116	218	48 42	1 18	16
15	5 8 24	19 24	,8884	151	53 18	0 54	12 1 48	4 49	,1054	342	6 19	2 3	7 26 40	25 9	,8334	206	50 0	1 14	15
16	5 27 48	19 10	,8733	160	52 24	0 58	12 6 37	4 1	,0712	345	4 16	2 4	7 1 31	26 2	,8540	195	51 14	1 10	14
17	5 46 58	18 56	,8573	170	51 26	1 1	12 10 38	3 12	,0367	347	2 12	2 5	6 35 29	26 54	,8735	182	52 24	1 6	13
18	6 5 54	18 40	,8403	178	50 25	1 4	12 13 50	2 21	,0020	347	0 7	2 5	6 8 35	27 42	,8917	168	53 30	1 0	12
19	6 24 34	18 24	,8225	187	49 21	1 7	12 16 11	1 29	,0327	348	1 58	2 5	5 40 53	28 27	,9085	155	54 30	0 56	11
20	6 42 58	18 6	,8038	196	48 14	1 11	12 17 40	0 35	,0675	349	4 3	2 6	5 12 26	29 9	,9240	142	55 26	0 52	10
21	7 1 4	17 48	,7842	205	47 3	1 14	12 18 15	0 19	,1024	349	6 9	2 5	4 43 17	29 47	,9382	128	56 18	0 46	9
22	7 18 52	17 28	7637	212	45 49	1 16	12 17 56	1 15	,1373	349	8 14	2 6	4 13 30	30 23	,9510	113	57 4	0 40	8
23	7 36 20	17 8	,7425	221	44 33	1 20	12 16 41	2 12	,1722	347	10 20	2 5	4 43 7	30 53	,9623	99	57 44	0 36	7
24	7 53 28	16 46	,7204	229	43 13	1 22	12 14 29	3 11	,2069	347	12 25	2 5	3 12 14	31 21	,9722	84	58 28	0 30	6
25	8 10 14	16 24	,6975	236	41 51	1 25	12 11 18	4 10	,2416	346	14 30	2 4	2 40 53	31 43	,9806	70	58 50	0 25	5
26	8 26 38	16 1	,6739	245	40 26	1 28	12 7 8	5 10	,2762	342	16 34	2 3	2 9 10	32 1	9876	53	59 15	0 19	4
27	8 42 39	15 36	,6494	252	38 58	1 31	12 1 58	6 11	,3104	340	18 37	2 3	1 37 9	32 15	,9929	39	59 34	0 14	3
28	8 58 15	15 10	,6242	258	37 27	1 33	11 55 47	7 14	,3444	337	20 40	2 1	1 4 54	32 25	,9968	24	59 48	0 9	2
29	9 13 25	14 13	,5984	266	35 54	1 36	11 48 33	8 17	,3781	333	22 41	2 0	0 32 29	32 29	,9992	8	59 57	0 3	1
30	9 28 8		,5718		34 18		11 40 16		,4114		24 41		0 0 0		1.		60 0		0
⊙ à ☽ ap	2d Equ. ☽ Apog. —	Dif.	X^rs for C.Eq. above	D.	Se^l X^s for c.e above	D.	2d Equa. ☽ Apog. —	Dif.	X^rs for C.Eq. under	D.	Se^l X^s for c.e under	D.	2d Equa. ☽ Apo. —	Dif.	X^rs for C.Eq. under	D.	Se^l X^s for c.e under	D.	⊙ à ☽ ap.
	Sig. 11. 5.						Sig. 10. 4.						Sig. 9. 3						

CONSTRUCTION *of 2d Equation* ☽ *Apogee.*

As Gr. Ecc^y 66782 : Least Ecc^y 43319 :: Tan. Arg of ⊙ à ☽ Ap. : To T. 4th Arc, which deducted from the said Annual Arg. leaves the 2d Equat. ☽ Ap. sought.

Ex. *To find 2d Equation* ☽ *Ap. for* 1^s 21° ⊙ à ☽ *Apogee?*

	Com. Log.
To Conf. Log	9.8120190
Add T. 1^s 21° Arg. or 51°	10.0916308 +
4th. T. 1 8 41′ 45″	9.9036498

Dif. 12° 18′ 15″ Eq. *required.* So for the Rest.

CONSTRUCTION of the *Decimal* and *Sexagesimal* MULTIPLIERS into the *Gr. Dif.* under or above the *M. Central Equat.* See P. 66, 67 and 68 following.

As 11732 gr. Dif. Ecc^y under or above the Mean : G. D. under or above M. Centr. Eq. :: Dif. Ecc^y correspondent to the Arg. of Eq. : Pres. Dif. under or above the *M. Central Equation.*

Hence $\frac{\text{Pres. Dif. Ecc}^y\text{ fr. Mean}}{11732}$ = *Decimal* Multip^r. (= Parts of a Degree of Sex^l Multip^r.) which X^d into G. Dif. Eq. = Pres. Dif. from M. Centr^l. Eq. req^d.—*For Construction of Eccentr.* ☽ *Orb.* See farther on.

EXAM. *In* 1^s 7° 40′ 27″ ⊙ à ☽'s Ap. *to find the Multipliers to the Gr. Dif. Eq. in the following Tables, p.* 66, 67 *and* 68.

For 1^s 7° ⊙ à ☽'s Ap. { Dif. Ecc^y ab. M. 4315 / G. Ecc^y ab. M. 11732 } . . . . . . = D. Mul^r. ,3678 — ,211 = ,3467; Sex. Mul^r. = 22′ 4″ — 1 16 = 20 48 Mul^{rs} req^d.

Exc. Arg. 40′,45 = 40′ 27″

{By Tab. above, 1° more = — 314

16180
4045
12135
1270|1,30

$\frac{1}{6}$ —211,6 Parts.

By Log. Log^s.

	L. L.
Exc. Ar. 40′ 27″	0.1712
Dif. — 1 53	1.5032
Pro^l Dif.—1 16	1.6744

— Parts 314 for 1°.. 5 14
— Parts 212 = 3 32

By Logist. Logs.

	L. L.
Exc. Arg. 40′ 27″	0.1712
	1.0594
	1.2306

SUPPLEMENTAL LUNAR TABLES.

SEMIANNUAL or SECOND EQUATION of the MOON's APOGEE, from the *Horroxian* THEORY. With *Decimal* and *Sexagesimal* Multipliers into the *Greatest* Difference under and above the Mean ELLIPTIC EQUATION of the MOON's CENTER. For finding, directly, the present correct Difference from the Mean, and thence the *whole* ELLIPTIC EQUATION of the MOON. According to our *New Method* of Computing.

Argument. SUN from the MOON's APOGEE, or Sun's True Place — Moon's Apogee 1 Equated.

☉ à ☽ ap.	Sig. 0. 6.						Sig. 1. 7.						Sig. 2. 8.						☉ à ☽ ap.
	Equat. ☽ Apo.	Dif	Xrs for C. Eq.	D.	Sex^l X forc. e	D.	Equat. ☽ Apog.	Dif.	Xrs for C. Eq.	D.	Sel Xs forc. e	D.	Equat. ☽ Apo.	Dif.	Xrs for C. Eq.	D.	Sel Xs forc. e	D.	
	+		above		above		+		above		above		+		under		under		
°	° ′ ″	′ ″			′ ″	′ ″	° ′ ″	′ ″			′ ″	′ ″	° ′ ″	′ ″			′ ″	′ ″	°
0	0 0 9	20 21	1,0000	6	60 0	0 3	9 7 14	13 38	,5000	305	30 0	1 59	11 8 55	9 10	,5000	298	30 0	1 47	30
1	0 20 21	20 21	,9994	18	59 57	0 6	9 20 52	13 19	,4695	311	28 10	1 52	10 59 45	10 10	,5298	294	31 47	1 46	29
2	0 40 42	20 19	,9976	30	59 51	0 11	9 34 1	12 39	,4384	317	26 18	1 54	10 49 35	11 13	,5592	286	33 33	1 43	28
3	1 1 1	20 16	,9946	43	59 40	0 15	9 46 40	12 9	,4067	321	24 24	1 56	10 38 22	12 15	,5878	278	35 16	1 40	27
4	1 21 17	20 13	,9903	55	59 25	0 20	9 58 49	11 35	,3746	327	22 28	1 57	10 26 7	13 17	,6156	272	36 56	1 38	26
5	1 41 30	20 10	,9848	67	59 5	0 24	10 10 24	11 5	,3419	329	20 31	1 59	10 12 50	14 19	,6428	264	38 34	1 35	25
6	2 1 40	20 4	,9781	78	58 41	0 28	10 21 29	10 29	,3090	334	18 32	2 0	9 58 31	15 21	,6692	255	40 9	1 32	24
7	2 21 44	19 58	,9703	91	58 13	0 33	10 31 58	9 52	,2756	337	16 32	2 1	9 43 10	16 22	,6947	247	41 41	1 29	23
8	2 41 42	19 52	,9612	102	57 40	0 36	10 41 50	9 18	,2419	340	14 31	2 3	9 26 48	17 24	,7194	237	43 10	1 25	22
9	3 1 34	19 44	,9510	113	57 4	0 41	10 51 8	8 40	,2079	343	12 28	2 3	9 9 24	18 24	,7431	230	44 35	1 23	21
10	3 21 18	19 36	,9397	125	56 23	0 45	10 59 48	7 59	,1736	344	10 25	2 4	8 51 0	19 24	,7661	219	45 58	1 19	20
11	3 40 54	19 28	,9272	137	55 38	0 49	11 7 47	7 20	,1392	347	8 21	2 5	8 31 36	20 22	,7880	210	47 17	1 15	19
12	4 0 22	19 16	,9135	147	54 49	0 53	11 15 7	6 38	,1045	348	6 16	2 5	8 11 14	21 19	,8090	206	48 32	1 12	18
13	4 19 38	19 6	,8988	158	53 56	0 57	11 21 45	5 55	,0697	348	4 11	2 5	7 49 55	22 15	,8290	190	49 44	1 9	17
14	4 38 44	18 54	,8830	170	52 59	1 1	11 27 40	5 11	,0349	349	2 6	2 6	7 27 40	23 19	,8480	180	50 53	1 5	16
15	4 57 38	18 42	,8660	180	51 58	1 5	11 32 51	4 26	± 0	349	± 0	2 6	7 4 31	24 1	,8660	170	51 58	1 1	15
16	5 16 20	18 29	,8480	190	50 53	1 9	11 37 17	3 38	,0349	348	2 6	2 5	6 40 30	24 50	,8830	158	52 59	0 57	14
17	5 34 49	18 13	,8290	200	49 44	1 12	11 30 55	2 52	,0697	348	4 11	2 5	6 15 40	25 38	,8988	147	53 56	0 53	13
18	5 53 2	18 59	,8090	210	48 32	1 15	11 43 47	2 2	,1045	347	6 16	2 5	5 50 2	26 23	,9135	137	54 49	0 49	12
19	6 11 1	17 41	,7880	219	47 17	1 19	11 45 49	1 12	,1392	344	8 21	2 4	5 23 39	27 5	,9272	125	55 38	0 45	11
20	6 28 42	17 26	,7661	230	45 58	1 23	11 47 1	0 11	,1736	343	10 25	2 3	4 56 34	27 43	,9397	113	56 23	0 41	10
21	6 46 8	17 7	,7431	238	44 35	1 26	11 47 22	0 32	,2079	340	12 28	2 3	4 28 51	28 19	,9510	102	57 4	0 36	9
22	7 3 15	16 48	,7193	246	43 9	1 28	11 46 50	1 26	,2419	337	14 31	2 1	4 0 32	28 52	,9612	91	57 40	0 33	8
23	7 20 3	16 27	,6947	255	41 41	1 32	11 45 24	2 20	,2756	334	16 32	2 0	3 31 40	29 20	,9703	78	58 13	0 28	7
24	7 36 39	16 6	,6692	264	40 9	1 35	11 43 4	3 17	,3090	330	18 32	1 59	3 2 20	29 44	,9781	67	58 41	0 24	6
25	7 52 36	15 44	,6428	272	38 34	1 38	11 39 47	4 13	,3420	326	20 31	1 57	2 32 36	30 6	,9848	55	59 5	0 20	5
26	8 8 20	15 21	,6156	278	36 56	1 40	11 35 34	5 11	,3746	321	22 28	1 56	2 2 30	30 22	,9903	43	59 25	0 15	4
27	8 23 41	15 57	,5878	287	35 16	1 43	11 30 23	6 9	,4067	317	24 24	1 54	1 32 8	30 38	,9946	30	59 40	0 11	3
28	8 38 38	14 30	,5591	293	33 33	1 46	11 24 14	7 9	,4384	311	26 18	1 52	1 1 30	30 45	,9976	18	59 51	0 6	2
29	8 53 8	14 6	,5298	298	31 47	1 47	11 17 5	8 10	,4695	305	28 10	1 50	0 30 45	30 45	,9994	6	59 57	0 3	1
30	9 7 14		,5000		30 0		11 8 55		,5000		30 0		0 0 0		1,0000		60 0		0
☉ à ☽ ap.	—		above		above		—		under		under		—		under		under		☉ à ☽ ap.
	Equat. ☽ Apog.	Dif.	Xrs for C. Eq.	D.	Sel X: forc. e	D.	Equat. ☽ Apog.	Dif.	Xrs for C. Eq	D.	Sel Xs forc. e	D.	Equat. ☽ Apo.	Dif.	Xrs for C. Eq.	D.	Sel Xs forc. e	D.	
	Sig. 11. 5.						Sig. 10. 4.						Sig. 9. 3.						

THE above *Construction* of the DECIMAL and SEXAGESIMAL MULTIPLIERS is according to *different Eccentricities* from the former; *viz.* 66854 the *Greatest*, 55237 the Mean, and 43619 the *Least* Eccentricity: but in the same Manner constructed. A Table of which different *Eccentricities* we have inserted farther on; that the Principles may be examined on which these Tables are founded.

SUPPLEMENTAL LUNAR TABLES.

IV. MEAN CENTRAL EQUATION of the MOON, from the *Newtonian* THEORY. With the *Greatest* Difference of EQUATION *under* and *above* the MEAN EQUATION correspondent to the *Least* and *Greatest* ECCENTRICITIES, 43319 and 66782 to Mean Dist. à ☉ 1000000. According to our NEW METHOD of *Computing*.

Argument. MOON's Equated ANOMALY; Or ☽. 3. Equated — ☽ Apogee 2. Equated.

Sign 0.

☽ Eq A. (°)	greatest dif. Eq. — under (′ ″)	Dif. (′ ″)	In. fr. M. + (″)	Mean Cent Eq. ☽ — (° ′ ″)	Dif. (′ ″)	Great. Dif. Æ. + above (′ ″)	D. (′ ″)	De fr. M. — (″)
0	0 0	1 15	0	0 0 0	6 11	0 0	1 12	0
1	1 15	1 15	1	0 6 11	6 11	1 12	1 13	1
2	2 30	1 15	1	0 12 22	6 10	2 25	1 14	1
3	3 45	1 15	1	0 18 32	6 10	3 39	1 13	1
4	5 0	1 15	1	0 24 42	6 10	4 52	1 12	1
5	6 15	1 15	1	0 30 52	6 10	6 4	1 13	1
6	7 30	1 14	2	0 37 2	6 9	7 17	1 12	1
7	8 44	1 14	2	0 43 10	6 8	8 29	1 12	2
8	9 58	1 14	2	0 49 19	6 7	9 41	1 13	2
9	11 12	1 14	2	0 55 26	6 6	10 54	1 12	2
10	12 26	1 14	2	1 1 32	6 6	12 6	1 12	3
11	13 40	1 14	2	1 7 38	6 5	13 18	1 12	3
12	14 54	1 14	3	1 13 43	6 3	14 30	1 13	3
13	16 8	1 14	3	1 19 46	6 2	15 43	1 12	3
14	17 22	1 14	3	1 25 48	6 2	16 55	1 10	3
15	18 36	1 13	3	1 31 50	6 0	18 5	1 12	3
16	19 49	1 13	3	1 37 50	5 58	19 17	1 11	3
17	21 2	1 13	3	1 43 48	5 57	20 28	1 9	3
18	22 15	1 12	4	1 49 45	5 55	21 37	1 10	4
19	23 27	1 12	4	1 55 40	5 53	22 47	1 12	4
20	24 39	1 11	4	2 1 33	5 51	23 59	1 10	4
21	25 50	1 10	4	2 7 24	5 50	25 9	1 9	4
22	27 0	1 10	4	2 13 14	5 47	26 18	1 11	4
23	28 10	1 10	4	2 19 1	5 45	27 29	1 10	4
24	29 22	1 11	4	2 24 46	5 44	28 39	1 6	4
25	30 33	1 11	5	2 30 30	5 41	29 45	1 10	4
26	31 44	1 9	5	2 36 11	5 38	30 55	1 8	5
27	32 53	1 10	5	2 41 49	5 35	32 3	1 5	5
28	34 3	1 6	5	2 47 26	5 32	33 8	1 10	5
29	35 9	1 11	5	2 52 58	5 32	34 18	1 6	6
30	36 20		6	2 58 30		35 24		6
☽ Eq A.	under. — greatest dif. Eq.	Dif.	+ In. fr. M.	+ Mean Cent Eq. ☽	Dif.	above + Great. Dif. E.	D.	— De fr. M.

Sig. 11

Sig. 1.

☽ Eq A. (°)	Great. Dif. E. — under (′ ″)	D. (′ ″)	In. fr. M. + (″)	Mean Cent Eq. ☽ — (° ′ ″)	Dif. (′ ″)	Great. Dif. E. + above (′ ″)	D. (′ ″)	De. fr. M. — (″)	☽ Eq A. (°)
0	36 20	1 5	6	2 58 30	5 28	35 24	1 7	6	30
1	37 25	1 10	6	3 3 58	5 26	36 31	1 5	6	29
2	38 35	1 6	6	3 9 24	5 22	37 36	1 6	6	28
3	39 41	1 7	6	3 14 46	5 19	38 42	1 6	6	27
4	40 48	1 9	7	3 20 5	5 16	39 48	1 5	6	26
5	41 51	1 7	7	3 25 21	5 14	40 53	1 4	6	25
6	42 58	1 4	7	3 30 35	5 10	41 57	1 4	6	24
7	44 2	1 4	7	3 35 45	5 6	43 1	1 1	6	23
8	45 6	1 4	7	3 40 51	5 4	44 3	1 4	6	22
9	46 10	1 3	7	3 45 55	5 0	45 7	1 1	6	21
10	47 13	1 1	7	3 50 55	4 55	46 8	1 2	6	20
11	48 14	1 1	7	3 55 50	4 53	47 10	1 0	6	19
12	49 15	1 3	7	4 0 43	4 49	48 10	1 0	7	18
13	50 18	0 58	7	4 5 32	4 45	49 10	0 59	7	17
14	51 16	0 59	7	4 10 17	4 40	50 9	0 59	7	16
15	52 15	1 0	7	4 14 57	4 37	51 8	1 0	7	15
16	53 15	0 59	7	4 19 34	4 33	52 8	0 55	7	14
17	54 14	0 56	8	4 24 7	4 29	53 3	0 58	8	13
18	55 10	0 56	7	4 28 36	4 26	54 1	0 58	7	12
19	56 6	0 55	7	4 33 0	4 20	54 59	0 55	7	11
20	57 1	0 57	7	4 37 20	4 16	55 54	0 55	7	10
21	57 58	0 52	7	4 41 36	4 11	56 49	0 54	6	9
22	58 50	0 55	7	4 45 47	4 6	57 43	0 54	6	8
23	59 45	0 50	7	4 49 53	4 2	58 37	0 52	6	7
24	60 35	0 53	7	4 53 55	3 58	59 29	0 51	6	6
25	61 28	0 50	7	4 57 53	3 52	60 20	0 52	6	5
26	62 18	0 49	7	5 1 45	3 47	61 12	0 50	6	4
27	63 7	0 52	7	5 5 32	3 43	62 2	0 49	6	3
28	63 59	0 46	7	5 9 15	3 37	62 51	0 49	6	2
29	64 45	0 47	7	5 12 52	3 33	63 40	0 48	6	1
30	65 32		7	5 16 25		64 28		6	0
☽ Eq A.	under — Great. Dif. E.	D.	+ In. fr. M.	+ Mean Cent Eq. ☽	Dif.	above + Great. Dif. E.	D.	— De. fr M.	☽ Eq A.

Sig. 10

EXAMPLE I. *To find the* MOON's *Central Equation correspondent to* 2s 8° ☉ à ☽ *Apogee, and* 1s 11° ☽ *Equated Anomaly?*

By Tab. above. M. Cen. Eq. ☽ 14″ L. L.

1s 11° ☽ Eqd. Anom. — 3° 55′ 50″ . . . . . . — 48′,233 G. D. Eq. under } Or, — 48′ 14″ | 0.0948

—31 47 By Tab. p. 64 . . ,659 D. Multiplier } Sexl. ×r. 39 32 | 0.1812

Propl. D. 31 47 | 0.2760

☽ Central Equation — 3 24 3 required. 434097 [as before.

very nearly. 241165

For *Correction.* 289398

Against 1s 11° Equated Anom. . . . +7″

Increase from Mean, to be allowed in the two of three Parts from M. to Extreme, into which the *G. Dif.* is supposed divided. In 3d Part nothing allowed. — 3 24 10 *corrected.*

—31′,785547

47″ ×8 by 6.

But . . ,659 = 39′ 32″

39,′54 } multiply8

32,″4 } by 6.

N. B. *When the* Arguments *exceed whole Degrees, Proportion of the Equations must be made* (as usual) *for that* Excess.

SUPPLEMENTAL LUNAR TABLES.

IV. MEAN CENTRAL EQUATION of the MOON, from the *Newtonian* THEORY. With the *Greatest* Difference of EQUATION, *under* and *above* the MEAN EQUATION, correspondent to the *Least* and *Greatest* ECCENTRICITIES, 43319 and 66782 to Mean Dist. à Sun 1000000. According to our NEW METHOD of *Computing*.

Argument. MOON's Equated ANOMALY, Or, ☽. 3 Equated — ☽ Apogee 2. Equated.

☽ Eq A.	Sig. 2. greatest Dif. E. — under	Dif.	In. fr M. +	Mean Cent Eq. ☽ —	Dif.	greatest Dif. E + above	Dif.	De fr. M. —
°	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″
0	65 32	0 47	7	5 16 25	3 28	64 28	0 45	6
1	66 19	0 45	7	5 19 53	3 21	65 13	0 47	6
2	67 4	0 43	7	5 23 14	3 16	66 0	0 46	6
3	67 47	0 42	7	5 26 30	3 12	66 46	0 42	6
4	68 29	0 43	7	5 29 42	3 6	67 28	0 44	6
5	69 12	0 41	6	5 32 48	3 0	68 12	0 42	6
6	69 52	0 42	6	5 35 48	2 53	68 54	0 40	6
7	70 34	0 38	6	5 38 43	2 39	69 34	0 41	6
8	71 12	0 37	6	5 41 32	2 43	70 15	0 38	6
9	71 49	0 36	6	5 44 15	2 38	70 53	0 35	6
10	72 25	0 33	6	5 46 53	2 32	71 32	0 36	6
11	72 58	0 38	6	5 49 25	2 26	72 8	0 32	6
12	73 36	0 31	6	5 51 51	2 20	72 40	0 38	6
13	74 7	0 33	5	5 54 11	2 13	73 18	0 33	6
14	74 40	0 30	5	5 56 24	2 8	73 51	0 33	6
15	75 10	0 30	5	5 58 32	2 2	74 24	0 32	6
16	75 40	0 28	5	6 0 34	1 55	74 56	0 30	5
17	76 8	0 27	5	6 2 29	1 49	75 26	0 30	5
18	76 35	0 22	5	6 4 18	1 44	75 56	0 26	4
19	77 1	0 25	4	6 6 2	1 36	76 22	0 27	4
20	77 26	0 23	4	6 7 38	1 30	76 49	0 24	4
21	77 49	0 22	4	6 9 8	1 24	77 13	0 27	4
22	78 11	0 20	4	6 10 32	1 17	77 40	0 22	4
23	78 31	0 21	4	6 11 49	1 11	78 2	0 21	4
24	78 51	9 15	4	6 13 0	1 4	78 23	0 19	3
25	79 6	0 19	4	6 14 4	0 57	78 42	0 19	3
26	79 25	0 14	3	6 15 1	0 51	79 1	0 18	3
27	79 39	0 14	3	6 15 52	0 44	79 19	0 17	3
28	79 53	0 12	3	6 16 36	0 37	79 36	0 15	3
29	80 5	0 12	3	6 17 13	0 34	79 51	0 12	3
30	80 17		3	6 17 44		80 3		3
			3					
☽ Eq A.	under — greatest dif. Eq. Sig. 9.	Dif.	+ In. fr. M.	+ Mean Cent Eq. ☽	Dif.	above + greatest Dif. E.	Dif.	+ De fr. M.

Sig. 3. greatest Dif. E. — under	Dif.	In & D. fr M. ±	Mean Cent Eq. ☽ —	Dif.	greatest Dif. E. + above	Dif.	D. & In. fr M. ∓	☽ Eq A.
′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	°
80 17	0 10	2	6 17 44	0 24	80 3	0 13	2	30
80 27	0 8	2	6 18 8	0 17	80 16	0 9	2	29
80 35	0 6	2	6 18 25	0 10	80 25	0 10	2	28
80 41	0 6	2	6 18 35	0 3	80 35	0 8	1	27
80 47	0 3	1	6 18 38	0 4	80 43	0 7	1	26
80 50	0 2	0	6 18 34	0 11	80 50	0 4	0	25
80 52	0 1	—	6 18 23	0 18	80 54	0 4	+	24
80 53	0 0	1	6 18 5	0 24	80 58	0 2	1	23
80 53	0 2	1	6 17 41	0 32	81 0	0 0	1	22
80 51	0 4	1	6 17 9	0 39	81 0	0 0	1	21
80 47	0 5	1	6 16 30	0 45	81 0	0 5	1	20
80 42	0 6	1	6 15 45	0 53	80 55	0 3	1	19
80 36	0 8	2	6 14 52	1 0	80 52	0 6	2	18
80 28	0 12	2	6 13 52	1 8	80 46	0 6	2	17
80 16	0 11	2	6 12 44	1 14	80 40	0 10	3	16
80 5	0 13	2	6 11 30	1 21	80 30	0 9	3	15
79 52	0 15	3	6 10 9	1 29	80 21	0 13	4	14
79 37	0 13	3	6 8 40	1 35	80 8	0 13	4	13
79 24	0 21	3	6 7 5	1 42	79 55	0 15	4	12
79 3	0 18	3	6 5 23	1 49	79 40	0 17	4	11
78 45	0 21	3	6 3 34	1 57	79 23	0 21	4	10
78 24	0 23	4	6 1 37	2 3	79 2	0 19	4	9
78 1	0 25	4	5 59 34	2 11	78 43	0 22	4	8
77 36	0 24	4	5 57 23	2 17	78 21	0 23	5	7
77 12	0 28	4	5 55 6	2 25	77 58	0 24	5	6
76 44	0 29	5	5 52 41	2 31	77 34	0 27	5	5
76 15	0 29	5	5 50 10	2 38	77 7	0 29	6	4
75 46	0 36	5	5 47 32	2 46	76 48	0 39	6	3
75 10	0 32	5	5 44 46	2 53	76 9	0 31	6	2
74 38	0 35	5	5 41 53	2 59	75 38	0 35	6	1
74 3		5	5 38 54		75 3		6	0
under — greatest Dif. E. Sig. 8.	Dif.	± D. & In. fr M.	+ Mean Cent Eq. ☽	Dif.	above + greatest Dif. E.	Dif.	∓ In & D. fr M.	☽ Eq A.

The *Ease* and *Readiness* of this NEW METHOD of taking out the *Equation* of the MOON's CENTER, (where 2d Equation ☽'s Apog. is retained) appear evident from the foregoing EXAMPLE.

SUPPLEMENTAL LUNAR TABLES.

IV. MEAN CENTRAL EQUATION of the MOON, from the *Newtonian* THEORY. With the *Greatest* Difference of EQUATION, *under* and *above* the MEAN EQUATION, correspondent to the *Least* and *Greatest* ECCENTRICITIES, 43319 and 66782 to Mean Dist. à Sun 1000000. According to our NEW METHOD of *Computing*.

Argument. MOON's Equated ANOMALY, Or, ☽. 3 Equated — ☽. Apogee 2. Equated.

☽ Eq An	Sig. 4. greatest Dif. E. — under	Dif.	De fr. M. —	Mean Cent Eq. ☽ —	Dif.	greatest Dif. E. + above	Dif.	In. fr. M. +	Sig. 5. greatest Dif. E. — under	Dif.	De. fr. M. —	Mean Cent Eq. ☽ —	Dif.	greatest Dif. E. + above	Dif.	In. fr. M. +	☽ Eq A.
°	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	°
0	74 3	0 35	5	5 38 54	3 5	75 3	0 34	6	44 56	1 21	7	3 21 6	5 59	46 7	1 19	7	30
1	73 28	0 39	5	5 35 49	3 13	74 29	0 39	7	43 35	1 20	7	3 15 7	6 3	44 48	1 22	7	29
2	72 49	0 40	6	5 32 36	3 19	73 50	0 36	7	42 15	1 21	7	3 9 4	6 7	43 26	1 26	7	28
3	72 9	0 43	6	5 29 17	3 27	73 14	0 39	7	40 54	1 22	7	3 2 57	6 13	42 6	1 24	7	27
4	71 26	0 43	6	5 25 50	3 32	72 35	0 43	7	39 32	1 24	6	2 56 44	6 15	40 42	1 26	7	26
5	70 43	0 45	7	5 22 18	3 39	71 52	0 43	7	38 8	1 22	6	2 50 29	6 18	39 10	1 25	6	25
6	69 58	0 45	7	5 18 39	3 46	71 9	0 45	7	36 46	1 25	6	2 44 11	6 23	37 51	1 27	6	24
7	69 13	0 48	7	5 14 53	3 52	70 24	0 47	7	34 21	1 25	6	2 37 48	6 25	36 24	1 30	6	23
8	68 25	0 50	7	5 11 1	3 58	69 37	0 48	7	33 56	1 27	6	2 31 23	6 30	34 54	1 26	6	22
9	67 35	0 51	8	5 7 3	4 6	68 49	0 48	8	32 29	1 27	6	2 24 53	6 33	33 28	1 29	6	21
10	66 44	0 51	7	5 2 57	4 11	68 1	0 52	8	31 2	1 28	6	2 18 20	6 37	31 59	1 29	6	20
11	65 53	0 52	7	4 58 46	4 17	67 9	0 55	8	29 34	1 29	5	2 11 45	6 39	30 28	1 31	6	19
12	65 1	0 56	7	4 54 29	4 24	66 14	0 53	8	28 5	1 30	5	2 5 6	6 41	28 57	1 34	6	18
13	64 5	0 57	7	4 50 5	4 30	65 21	0 56	8	26 35	1 30	5	1 58 25	6 44	27 23	1 31	5	17
14	63 8	1 0	7	4 45 35	4 36	64 25	0 58	8	25 5	1 30	5	1 51 41	6 47	25 52	1 35	5	16
15	62 8	0 58	7	4 40 59	4 41	63 27	0 58	8	23 35	1 32	4	1 44 54	6 49	24 17	1 33	5	15
16	61 10	1 1	7	4 36 18	4 47	62 29	1 2	8	22 3	1 32	4	1 38 5	6 51	22 44	1 33	5	14
17	60 9	1 3	7	4 31 31	4 54	61 27	1 2	8	20 31	1 32	4	1 31 14	6 53	21 11	1 35	5	13
18	59 6	1 3	8	4 26 37	4 58	60 25	1 4	8	18 59	1 34	3	1 24 21	6 55	19 36	1 38	5	12
19	58 3	1 7	8	4 21 39	5 5	59 21	1 4	8	17 25	1 34	3	1 17 26	6 55	17 58	1 36	4	11
20	56 56	1 7	7	4 16 34	5 9	58 17	1 7	8	15 51	1 34	3	1 10 29	6 58	16 22	1 37	4	10
21	55 49	1 8	8	4 11 25	5 16	57 10	1 8	8	14 7	1 35	3	1 3 31	7 1	14 45	1 37	3	9
22	54 41	1 7	8	4 6 9	5 20	56 2	1 10	8	12 42	1 34	2	0 56 30	7 1	13 8	1 38	3	8
23	53 34	1 11	8	4 0 49	5 25	54 52	1 12	8	11 8	1 35	2	0 49 29	7 1	11 30	1 40	3	7
24	52 23	1 13	8	3 55 24	5 32	53 40	1 13	8	9 33	1 35	2	0 42 28	7 3	9 50	1 37	2	6
25	51 10	1 12	7	3 49 52	5 36	52 27	1 13	8	7 58	1 36	1	0 35 25	7 4	8 13	1 38	1	5
26	49 58	1 13	7	3 44 16	5 40	51 14	1 15	7	6 22	1 35	1	0 28 21	7 5	6 35	1 38	1	4
27	48 45	1 17	7	3 38 36	5 46	49 59	1 15	7	4 47	1 35	1	0 21 16	7 5	4 57	1 41	1	3
28	47 28	1 16	7	3 32 50	5 50	48 44	1 19	7	3 12	1 36	1	0 14 11	7 5	3 16	1 38	1	2
29	46 12	1 16	7	3 27 0	5 54	47 25	1 18	7	1 36	1 36	0	0 7 6	7 6	1 38		0	1
30	44 56		7	3 21 6		46 7		7			0	0 0 0				0	0
☽ Eq A.	under — greatest Dif. E. Sig. 7.	Dif.	— De fr. M.	+ Mean Cent Eq. ☽	Dif.	above + greatest Dif. E.	Dif.	+ In. fr. M.	under — greatest Dif. E. Sig. 6.	Dif.	— De. fr. M.	+ Mean Cont. E. ☽	Dif.	above — greatest Dif. E.	Dif.	+ In. fr. M.	☽ Eq A.

EXAMPLE II. *To find the Equation of the* MOON's CENTER *answerable to* 1s 15° 20′. ☉ à ☽ *Ap. and* 3s 5° 44′ ☽ *Eq. Anom.*

M. Cen. Eq. ☽. G. D. Eq. above M.

By *Table* p. 67, 3s 5° 44′ ☽ eq. An. 6° 18′ 26″ . . . . . + 80′,883 (53″) } Or, + 80′ 53″ | L. L. 9.8703 co.

\+ 7 [illegible]36 By *Tab.* p. 64. ,094 D. ✕r } Sexl. ✕r. 5 38 | 1.0274

☽ Central Equation . . . . 6 26 2 required, *correctly.* 323532 Propl. Eqn. 7 36 *as before.* | 0.8977

727947

~~+7,60000~~ 36″

N. B. The Decl. ✕r ,094° [illegible] 38″ 5′,64 38″4 } multiply by 6.

Because 3s 5° and 6° An. have no *Correction* of *Increase* or *Decrease* of Equation from the Mean. } The foregoing agrees with the Result by Dr. *Halley's* Computation.

SUPPLEMENTAL LUNAR TABLES.

OR, IV. MEAN ELLIPTIC EQUATION of the MOON's CENTER from the *Horroxian* THEORY. With the greatest *Difference* of EQUATION, *under* and *above* the MEAN, correspondent to the *Least* and *Greatest* ECCENTRICITIES, 43619 and 66854, to Mean Distance à ☉ 1000000. According to our NEW METHOD of Computing.

Argument. MOON's Equated ANOMALY, Or ☽ 1 Equated — ☽ M. Ap. Equated by 2d. Eq. Ap.

☽ Eq An	Sig. 0. G. D. Equat. — under	Dif.	In. fr. M. +	Mean Cent Eq. ☽ —	Dif.	G. D. Equat. + above	Dif.	De fr. M. —	Sig. 1. G. D. Equat. — under	Dif.	In. fr. M. +	Mean Cent Eq. ☽ —	Dif.	G. D. Equat. + above	Dif.	De. fr. M. —	☽ Eq An
°	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	°
0	0 0	1 14	0	0 0 0	6 12	0 0	1 12	0	35 56	1 5	6	2 59 4	5 29	35 4	1 6	6	30
1	1 14	1 14	1	0 6 12	6 12	1 12	1 12	1	37 1	1 7	6	3 4 33	5 27	36 10	1 5	6	29
2	2 28	1 14	1	0 12 24	6 11	2 24	1 13	1	38 8	1 6	6	3 10 0	5 23	37 15	1 5	6	28
3	3 42	1 15	1	0 18 35	6 12	3 37	1 12	1	39 14	1 6	6	3 15 23	5 21	38 20	1 4	6	27
4	4 57	1 13	1	0 24 47	6 11	4 49	1 11	1	40 20	1 3	7	3 20 44	5 17	39 24	1 5	6	26
5	6 10	1 15	1	0 30 58	6 11	6 0	1 11	1	41 23	1 5	7	3 26 1	5 15	40 29	1 2	6	25
6	7 25	1 15	2	0 37 9	6 10	7 11	1 12	1	42 28	1 6	7	3 31 16	5 11	41 31	1 3	6	24
7	8 40	1 13	2	0 43 19	6 8	8 23	1 14	2	43 34	1 7	7	3 36 27	5 8	42 34	1 3	6	23
8	9 53	1 13	2	0 49 27	6 9	9 37	1 12	2	44 41	1 0	7	3 41 35	5 4	43 37	1 2	6	22
9	11 6	1 12	2	0 55 36	6 7	10 49	1 13	2	45 41	1 3	7	3 46 39	5 0	44 39	1 2	6	21
10	12 18	1 14	2	1 1 43	6 8	12 2	1 9	3	46 44	0 59	7	3 51 39	4 57	45 41	1 1	6	20
11	13 32	1 12	2	1 7 51	6 6	13 11	1 10	3	47 43	1 1	7	3 56 36	4 54	46 42	1 0	6	19
12	14 44	1 14	3	1 13 57	6 5	14 21	1 11	3	48 44	1 1	7	4 1 30	4 50	47 42	0 59	7	18
13	15 58	1 11	3	1 20 2	6 3	15 32	1 12	3	49 45	0 59	7	4 6 20	4 46	48 41	0 59	7	17
14	17 9	1 13	3	1 26 5	6 2	16 44	1 11	3	50 44	0 58	7	4 11 6	4 41	49 40	0 59	7	16
15	18 22	1 13	3	1 32 7	6 1	17 55	1 10	3	51 42	0 58	7	4 15 47	4 37	50 39	0 54	7	15
16	19 35	1 13	3	1 38 8	6 0	19 5	1 10	3	52 40	0 58	7	4 20 24	4 34	51 33	1 1	7	14
17	20 48	1 12	3	1 44 8	5 58	20 15	1 10	3	53 38	0 57	8	4 24 58	4 30	52 34	0 57	8	13
18	22 0	1 12	4	1 50 6	5 56	21 25	1 10	4	54 35	0 56	7	4 29 28	4 25	53 31	0 56	7	12
19	23 12	1 12	4	1 56 2	5 54	22 35	1 10	4	55 31	0 56	7	4 33 53	4 21	54 27	0 55	7	11
20	24 24	1 12	4	2 1 56	5 53	23 45	1 9	4	56 27	0 55	7	4 38 14	4 17	55 22	0 54	7	10
21	25 36	1 10	4	2 7 49	5 50	24 54	1 10	4	57 22	0 53	7	4 42 31	4 12	56 16	0 54	6	9
22	26 46	1 8	4	2 13 39	5 48	26 4	1 9	4	58 15	0 52	7	4 46 43	4 7	57 10	0 53	6	8
23	27 54	1 11	4	2 19 27	5 47	27 13	1 8	4	59 7	0 51	7	4 50 50	4 3	58 3	0 52	6	7
24	29 5	1 8	4	2 25 14	5 44	28 21	1 9	4	59 58	0 54	7	4 54 53	4 2	58 55	0 48	6	6
25	30 13	1 10	5	2 30 58	5 43	29 30	1 7	4	60 52	0 45	7	4 58 55	3 48	59 43	0 45	6	5
26	31 23	1 9	5	2 36 41	5 40	30 37	1 7	5	61 37	0 50	7	5 2 43	3 49	60 38	0 49	6	4
27	32 32	1 8	5	2 42 21	5 37	31 44	1 7	5	62 27	0 48	7	5 6 32	3 43	61 27	0 49	6	3
28	33 40	1 8	5	2 47 58	5 34	32 51	1 7	5	63 15	0 48	7	5 10 15	3 39	62 16	0 48	6	2
29	34 48	1 8	5	2 53 32	5 32	33 58	1 6	6	64 3	0 44	7	5 13 54	3 33	63 4	0 47	6	1
30	35 56		5	2 59 4		35 4		6	64 47		7	5 17 27		63 51		6	0
☽ Eq An	under — G. D. Equat.	Dif.	+ In. fr. M.	+ Mean Cent Eq. ☽	Dif.	above + G. D. Equat.	Dif.	± De fr. M.	under — G. D. Equnt.	Dif.	+ In. fr. M.	+ Mean Cent Eq. ☽	Dif.	above + G. D. Equat.	Dif.	— De. fr M.	☽ Eq An
	Sig. 11.								Sig. 10.								

EXAMPLE I. *To find the* MOON's *Elliptic or Central Equation correspondent to* 1ˢ 11° ☽ *Equated Anomaly, and* 2ˢ 8° ☉ à ☽ *Apogee, according to the Horroxian* THEORY?

	☉ à ☽ Ap.	Dec. ×ʳ.	Scl. ×ʳ.	
By Table, p. 65.	2ˢ 8°	,7194	43′ 10″	under Mean Eccentricity and Equation.

47′ 43″ = 47′,72
7194
50358
50358
28776
~~Proportional Equation~~ 34′,32574
19″ &c.

	Eq. An.	M. Cen. Eq.	G.D.Æ.und.	L.I.
By Tab. above	1ˢ 11°	3° 56′ 36″	47′ 43″	0.0995
		—34 20	43 10 ×ʳ	0.1430
☽ Central Eqⁿ. . . .		3 22 16 *nearly.*	—34 20 Propˡ. Eqⁿ.	0.2425
Corrⁿ to 1ˢ 11° Eq. An.		+ 7		
☽ Central Eq. required		3 22 23		

SUPPLEMENTAL LUNAR TABLES.

V. MEAN ELLIPTIC EQUATION of the MOON's CENTER from the *Horroxian* THEORY. With the greatest *Difference* of EQUATION, *under* and *above* the MEAN, correspondent to the *Least* and *Greatest* ECCENTRICITIES, 43619 and 66854, to Mean Distance à ☉ 1000000. According to our NEW METHOD of Computing.

Argument. MOON's Equated ANOMALY, Or ☽ 1 Equated — ☽ M. Ap. Equated by 2d. Eq. Ap.

Sig. 2. (at foot: Sig. 9.)

☉ Eq An	G. D. Equat. — under	Dif.	In. fr. M. +	Mean Cent Eq. ☽ —	Dif.	G. D. Equat. + above	Dif.	De fr. M. —	☉ Eq An
°	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	
0	64 47	0 49	7	5 17 27	3 27	63 51	0 47	6	30
1	65 36	0 45	7	5 20 54	3 23	64 38	0 44	6	29
2	66 21	0 46	7	5 24 17	3 18	65 23	0 43	6	28
3	67 7	0 40	7	5 27 35	3 12	66 5	0 44	6	27
4	67 47	0 42	7	5 30 47	3 6	66 40	0 43	6	26
5	68 29	0 45	6	5 33 53	3 1	67 32	0 42	6	25
6	69 14	0 35	6	5 36 54	2 55	68 14	0 41	6	24
7	69 49	0 38	6	5 39 49	2 50	68 55	0 40	6	23
8	70 27	0 38	6	5 42 39	2 45	69 35	0 37	6	22
9	71 5	0 36	6	5 45 24	2 38	70 12	0 40	6	21
10	71 41	0 36	6	5 48 2	2 33	70 52	0 34	6	20
11	72 17	0 35	6	5 50 35	2 27	71 20	0 35	6	19
12	72 52	0 32	6	5 53 2	2 20	72 1	0 34	6	18
13	73 24	0 31	5	5 55 22	2 14	72 35	0 34	6	17
14	73 55	0 30	5	5 57 36	2 8	73 9	0 32	6	16
15	74 25	0 28	5	5 59 44	2 2	73 41	0 31	6	15
16	74 53	0 27	5	6 1 46	1 56	74 12	0 30	5	14
17	75 20	0 27	5	6 3 42	1 49	74 42	0 29	5	13
18	75 47	0 26	5	6 5 31	1 44	75 11	0 27	4	12
19	76 13	0 24	4	6 7 15	1 37	75 38	0 26	4	11
20	76 37	0 24	4	6 8 52	1 31	76 4	0 25	4	10
21	77 1	0 22	4	6 10 23	1 23	76 29	0 24	4	9
22	77 23	0 23	4	6 11 46	1 17	76 53	0 24	4	8
23	77 46	0 16	4	6 13 3	1 11	77 17	0 21	4	7
24	78 2	0 19	4	6 14 14	1 5	77 38	0 19	3	6
25	78 21	0 18	4	6 15 19	0 58	77 57	0 18	3	5
26	78 39	0 15	3	6 16 17	0 51	78 15	0 17	3	4
27	78 54	0 13	3	6 17 8	0 4	78 32	0 17	3	3
28	79 7	0 12	3	6 17 52	0 37	78 49	0 16	3	2
29	79 19	0 10	3	6 18 29	0 30	79 5	0 13	3	1
30	79 29		3	6 18 59		79 18		3	0
☉ Eq An	under — G. D. Equat.	Dif.	+ In. fr. M.	+ Mean Cent Eq. ☽	Dif.	above + G. D Equat.	Dif.	— De fr. M.	

Sig. 3. (at foot: Sig. 8.)

☉ Eq An	G. D. Equat. — under	Dif.	In & D. fr M. ±	Mean Cent. Eq. ☽ —	Dif.	G. D. Equat. + above	Dif.	D. & In. fr M. ∓	☉ Eq An
°	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	°
0	79 29	0 6	2	6 18 59	0 24	79 18	0 11	2	30
1	79 35	0 9	2	6 19 23	0 17	79 29	0 11	2	29
2	79 44	0 7	2	6 19 40	0 10	79 40	0 10	2	28
3	79 51	0 5	2	6 19 50	0 4	79 50	0 7	1	27
4	79 56	0 6	1	6 19 54	0 3	79 57	0 5	1	26
5	80 2	0 2	0	6 19 51	0 11	80 2	0 5	0	25
6	80 4	0 2	—	6 19 40	0 17	80 7	0 3	+	24
7	80 3	0 0	1	6 19 23	0 26	80 10	0 2	1	23
8	80 3	0 2	1	6 18 57	0 32	80 12	0 0	1	22
9	80 1	0 3	1	6 18 25	0 39	80 12	0 0	1	21
10	79 58	0 4	1	6 17 46	0 46	80 12	0 3	1	20
11	79 54	0 5	1	6 17 0	0 52	80 9	0 5	1	19
12	79 49	0 8	2	6 16 8	1 0	80 4	0 6	2	18
13	79 41	0 11	2	6 15 8	1 8	79 58	0 6	2	17
14	79 30	0 11	2	6 14 0	1 14	79 52	0 9	3	16
15	79 19	0 13	2	6 12 46	1 21	79 43	0 11	3	15
16	79 6	0 13	3	6 11 25	1 29	79 32	0 11	4	14
17	78 53	0 18	3	6 9 56	1 36	79 21	0 13	4	13
18	78 35	0 19	3	6 8 20	1 43	79 8	0 15	4	12
19	78 16	0 19	3	6 6 37	1 49	78 53	0 18	4	11
20	77 57	0 22	3	6 4 48	1 57	78 35	0 18	4	10
21	77 35	0 21	4	6 2 51	2 3	78 17	0 19	4	9
22	77 14	0 21	4	6 0 48	2 11	77 56	0 21	4	8
23	76 53	0 30	4	5 58 37	2 18	77 35	0 24	5	7
24	76 23	0 27	4	5 56 19	2 25	77 11	0 25	5	6
25	75 56	0 29	5	5 53 54	2 31	76 46	0 27	5	5
26	75 27	0 31	5	5 51 23	2 40	76 19	0 27	6	4
27	74 56	0 32	5	5 48 43	2 46	75 52	0 30	6	3
28	74 24	0 33	5	5 45 57	2 53	75 22	0 31	6	2
29	73 51	0 35	5	5 43 4	2 59	74 51	0 33	6	1
30	73 16		5	5 40 5		74 18		6	0
	under — G. D Equat.	Dif.	± D & In. fr M.	+ Mean Cent. Eq. ☽	Dif.	above + G. D. Equat.	Dif.	∓ In & D. fr M.	☉ Eq An

EXAMPLE II. *To find the Equation of the* MOON's CENTER *answerable to* 1ˢ 15° 20′ ☉ à ☽ *Apog. and* 3ˢ 5° 44′ ☽ *Equated Anomaly.*

	☉ à ☽ Ap.	Dec. ×r.	Sel. ×r.	under
By Table p. 65.	1ˢ 15° 20.	,0116	0′ 42″	
	80′ 42″ =	80,06		
		0696		
		92800		
		,928696		
		55″,7		

	Eq. An.	M. Cen. Eq.	G. D. under	L. L.
By Tab. above	3ˢ 5° 44′	6° 19′ 43″	80′ 4″	0.1253 —
		— 56	0 42 ×r	1.9331 +
☽ Central Equation		6 18 47 *correctly*	—0 56 Propl. Eqn.	1.8078 +

For Correction from Tab. above = —0 .. for 3ˢ 5° 44′ Eq. An.

SUPPLEMENTAL LUNAR TABLES.

IV. MEAN ELLIPTIC EQUATION of the MOON's CENTER from the *Horroxian* THEORY. With the greatest *Difference* of EQUATION, *under* and *above* the MEAN, correspondent to the *Least* and *Greatest* ECCENTRICITIES, 43619 and 66854, to Mean Distance à ☉ 1000000. According to our NEW METHOD of Computing.

Argument. MOON's Equated ANOMALY, Or ☽ ı Equated — ☽ M. Ap. Equated by 2d Eq. Ap.

	Sig. 4.								Sig. 5.								
☽ Eq An	G. D. Equat. — under	Dif.	De fr. M. —	Mean Cent Eq. ☽ —	Dif.	G. D. Equat. + above	Dif.	In. fr. M. +	G. D. Equat. — under	Dif.	De. fr. M. —	Mean Cent Eq. ☽ —	Dif.	G. D. Equat. + above	Dif.	In. fr. M. +	☽ Eq An
°	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	′ ″	″	°
0	73 16	0 35	5	5 40 5	3 5	74 18	0 36	7	44 38	1 17	6	3 21 48	6 0	45 41	1 19	7	30
1	72 41	0 38	5	5 37 0	3 14	73 42	0 36	7	43 21	1 19	7	3 15 48	6 4	44 22	1 21	7	29
2	72 3	0 39	6	5 33 46	3 21	73 6	0 37	7	42 2	1 20	7	3 9 44	6 8	43 1	1 23	7	28
3	71 24	0 41	6	5 30 25	3 28	72 29	0 38	7	40 42	1 21	7	3 3 36	6 12	41 38	1 23	7	27
4	70 43	0 43	6	5 26 57	3 33	71 51	0 41	7	39 21	1 24	6	2 57 24	6 18	40 15	1 22	7	26
5	70 0	0 42	7	5 23 24	3 41	71 10	0 42	7	37 57	1 25	6	2 51 6	6 21	38 53	1 24	6	25
6	69 18	0 44	7	5 19 43	3 45	70 28	0 46	7	36 32	1 24	6	2 44 45	6 23	37 29	1 27	0	24
7	68 34	0 46	7	5 15 58	3 52	69 42	0 47	7	35 8	1 25	6	2 38 22	6 27	36 2	1 27	6	23
8	67 48	0 49	7	5 12 6	3 59	68 55	0 48	7	33 43	1 26	6	2 31 55	6 31	34 35	1 28	6	22
9	66 59	0 52	8	5 8 7	4 7	68 7	0 47	8	32 17	1 28	6	2 25 24	6 34	33 7	1 28	6	21
10	66 7	0 51	7	5 4 0	4 12	67 20	0 52	8	30 49	1 28	6	2 18 50	6 37	31 39	1 28	6	20
11	65 16	0 53	7	5 59 48	4 18	66 28	0 52	8	29 21	1 30	5	2 12 13	6 41	30 11	1 31	6	19
12	64 23	0 55	7	5 55 30	4 24	65 36	0 53	8	27 51	1 29	5	2 5 32	6 43	28 40	1 31	6	18
13	63 28	0 56	7	4 51 6	4 30	64 43	0 58	8	26 22	1 28	5	1 58 49	6 44	27 9	1 33	5	17
14	62 32	0 59	7	4 46 36	4 36	63 45	0 57	8	24 54	1 31	5	1 52 5	6 48	25 36	1 32	5	16
15	61 33	0 59	7	4 42 0	4 43	62 48	0 59	8	23 23	1 32	4	1 45 17	6 51	24 4	1 32	5	15
16	60 34	1 2	7	4 37 17	4 50	61 49	0 59	8	21 51	1 32	4	1 38 26	6 58	22 32	1 34	5	14
17	59 32	1 2	7	4 32 27	4 55	60 50	1 0	8	20 19	1 32	4	1 31 33	6 55	20 58	1 35	5	13
18	58 30	1 2	8	4 27 32	4 59	59 50	1 4	8	18 47	1 32	3	1 24 38	6 56	19 23	1 36	5	12
19	57 28	1 4	8	4 22 33	5 5	58 46	1 5	8	17 15	1 33	3	1 11 42	6 58	17 47	1 36	4	11
20	56 24	1 6	7	4 17 28	5 11	57 41	1 6	8	15 42	1 33	3	1 10 44	7 1	16 11	1 35	4	10
21	55 18	1 5	8	4 12 17	5 16	56 35	1 8	8	14 9	1 34	3	1 3 43	7 1	14 36	1 36	3	9
22	54 13	1 6	8	4 7 1	5 21	55 27	1 9	8	12 35	1 32	2	0 56 42	7 2	13 0	1 37	3	8
23	53 7	1 10	8	4 1 40	5 27	54 18	1 10	8	11 3	1 35	2	0 49 40	7 4	11 23	1 37	3	7
24	51 57	1 10	8	3 56 13	5 33	53 8	1 10	8	9 28	1 36	2	0 42 36	7 6	9 46	1 36	2	6
25	50 47	1 11	7	3 50 40	5 37	52 58	1 13	8	7 52	1 35	1	0 35 30	7 5	8 10	1 38	1	5
26	49 36	1 14	7	3 45 3	5 43	50 45	1 13	7	6 17	1 35	1	0 28 25	7 6	6 32	1 38	1	4
27	48 22	1 14	7	3 39 20	5 46	49 32	1 17	7	4 42	1 33	1	0 21 19	7 6	4 54	1 38	1	3
28	47 8	1 15	7	3 33 34	5 51	48 15	1 17	7	3 9	1 34	1	0 14 13	7 6	3 16	1 38	1	2
29	45 53	1 15	7	3 27 43	5 55	46 58	1 17	7	1 35	1 35	0	0 7 7	7 7	1 38	1 38	0	1
30	44 38		7	3 21 48		45 41		7	0 0		0	0 0 0		0 0		0	0
☽ Eq An	under — G. D. Equat.	Dif.	— De fr. M.	+ Mean Cent Eq. ☽	Dif.	above + G. D. Equat.	Dif.	+ In. fr. M.	under — G. D. Equat.	Dif.	— De fr. M.	+ Mean Cent Eq. ☽	Dif.	above + G. D. Equat.	Dif.	+ In. fr. M.	☽ Eq An
	Sig. 7.								Sig. 6.								

N. B. For other Methods of solving the *Elliptic Equation* of the MOON's CENTRE, See *further on.*

SUPPLEMENTAL LUNAR TABLES.

V. EQUATION, or Moon's Least and Greatest VARIATION, Sun in Apog. and Perigee, in respect of the Earth's Orbit: According to the *Newtonian Theory*.

Argument. MOON equated from the SUN.

☽ à ☉	Sig. 0. 6. L. Eq. ☉ in Ap. +	Dif.	G. D Per. +	Sig. 1. 7. L. Eq. ☉ in Ap. +	Dif.	G. D Per. +	Sig. 2. 8. L. Eq. ☉ in Ap. +	Dif.	G. D Per. +	☽ à ☉
°	′ ″	′ ″	″	′ ″	′ ″	″	′ ″	′ ″	″	°
0	0 0	1 9	0	28 41	0 34	208	28 41	0 34	208	30
1	1 9	1 9	8	29 15	0 31	112	28 7	0 38	203	29
2	2 18	1 10	17	29 40	0 29	216	27 29	0 40	198	28
3	3 28	1 9	25	30 15	0 29	219	26 49	0 42	194	27
4	4 37	1 8	33	30 44	0 24	223	26 7	0 43	189	26
5	5 45	1 9	42	31 8	0 23	226	25 24	0 47	184	25
6	6 54	1 7	50	31 31	0 20	228	24 37	0 47	178	24
7	8 1	1 7	58	31 51	0 18	231	23 50	0 49	173	23
8	9 8	1 7	66	32 9	0 16	233	23 1	0 51	167	22
9	10 15	1 5	74	32 25	0 13	235	22 10	0 52	161	21
10	11 20	1 4	82	32 38	0 11	236	21 18	0 53	154	20
11	12 24	1 4	90	32 49	0 8	238	20 25	0 57	148	19
12	13 28	1 3	98	32 57	0 7	239	19 28	0 57	141	18
13	14 31	1 2	105	33 4	0 4	239	18 31	0 57	134	17
14	15 33	1 2	113	33 8	0 2	240	17 34	0 59	127	16
15	16 35	0 59	120	33 10	0 2	240	16 35	1 2	120	15
16	17 34	0 57	127	33 8	0 4	240	15 33	1 2	113	14
17	18 31	0 57	134	33 4	0 7	239	14 31	1 3	105	13
18	19 28	0 57	141	32 57	0 8	239	13 28	1 4	98	12
19	20 23	0 53	148	32 49	0 11	238	12 24	1 4	90	11
20	21 18	0 52	154	32 38	0 13	238	11 10	1 5	82	10
21	22 10	0 51	161	32 25	0 16	235	10 15	1 7	74	9
22	23 1	0 49	167	32 9	0 18	233	9 8	1 7	66	8
23	23 59	0 47	173	31 51	0 20	231	8 1	1 7	58	7
24	24 37	0 47	178	31 31	0 23	228	6 54	1 9	50	6
25	25 24	0 43	184	31 8	0 24	226	5 45	1 8	42	5
26	26 7	0 42	189	30 44	0 29	223	4 37	1 9	33	4
27	26 49	0 40	194	30 15	0 29	219	3 28	1 10	25	3
28	27 29	0 38	198	29 40	0 31	216	2 18	1 9	17	2
29	28 7	0 34	203	29 15	0 34	212	1 9	1 9	8	1
30	28 41		208	28 41		208	0 0		0	0
☽ à ☉	L. Eq. ☉ in Ap. — Sig. 11. 5.	Dif.	G. D Per. +	L. Eq. ☉ in Ap — Sig. 10. 4	Dif.	G. D Per. +	L. Eq. ☉ in Ap. — Sig. 9 3.	Dif.	G. D Per. +	☽ à ☉

CONSTRUCTION. The *Variation* being without the ☽'s Octants with ☉.

As *Rad.* : *S. Doub. Dist.* ☽ *fr.* next Sizygy or Quadrature in Argt. as above :: *S. Gr. Variation in Octants* ☽ à ☉, ☉ being in Apogee and Perigee, respectively : *S. Pres. Equations* in Apog. and Perig. as above, *viz. Rad.* : *S.* 33′ 10″ *and S.* 37′ 10″ :: *S.* 2. ☽ à ☉ : *S. Pres. Equations in Ap. and Perig.* ☉.

Or, 33′ 10″ : 240″ :: any L. Eq. : G. D. as above.

i. e. ~~7,24~~ × any L. Eq. = G. D. as above.

And, *As* 33′ 10″ *gr. Eq. in Octants* ☽ *à* ☉, ☉ *being in Ap.* : *Pres. Eq. in Octants* ☽ *à* ☉ according to ☉ M. An. :: *Least Eq. Sun being in Ap.* : *Present Variation*, required.

N. B. See *Variation Tables* following, P. 73 and 74.

DECIMAL MULTIPLIERS to the Greatest Dif. above the *Least Variation*. The Product to be added thereto for *Present Variation*.

Argument. SUN's Mean ANOMALY.

☉ M. An	0 ×rs.	1 ×rs.	2 ×rs.	3 ×rs.	4 ×rs.	5 ×rs.	☉ M. An
°							°
0	,000	,065	,25	,5	,751	,935	30
1	,001	,07	,257	,507	,76	,939	29
2	,001	,074	,264	,516	,766	,943	28
3	,002	,079	,272	,525	,774	,946	27
4	,003	,083	,28	,534	,782	,95	26
5	,003	,088	,287	,543	,79	,954	25
6	,004	,092	,295	,552	,797	,958	24
7	,005	,098	,303	,561	,804	,961	23
8	,006	,104	,312	,57	,81	,964	22
9	,008	,109	,32	,578	,816	,968	21
10	,009	,115	,33	,587	,823	,971	20
11	,01	,121	,337	,596	,83	,974	19
12	,012	,126	,345	,605	,835	,977	18
13	,013	,133	,353	,614	,842	,981	17
14	,014	,14	,362	,622	,848	,985	16
15	,015	,146	,37	,63	,855	,989	15
16	,017	,152	,38	,64	,861	,993	14
17	,018	,158	,386	,647	,867	,996	13
18	,019	,165	,395	,655	,874	1.	12
19	,023	,171	,404	,664	,88	1.	11
20	,027	,177	,413	,672	,885	1.	10
21	,031	,183	,422	,68	,891	1.	9
22	,035	,19	,43	,688	,897	1.	8
23	,038	,195	,44	,687	,902	1.	7
24	,042	,201	,45	,705	,908	1.	6
25	,046	,21	,457	,713	,913	1.	5
26	,05	,217	,465	,720	,917	1.	4
27	054	,225	,473	,728	,922	1.	3
28	,057	,233	,482	,736	,926	1.	2
29	,061	,241	49	,743	,931	1.	1
30	,065	,25	,5	,751	,935	1.	0
☉ M. An	×rs. 11	×rs. 10	×rs. 9	×rs. 8	×rs. 7	×rs. 6	☉ M. An

CONSTRUCTION. As gr. Dif. Eq. ☽ in Octants à Sun (Sun in Apog. and Perig.) *viz.* 240″ : Pres. Dif. in Octants, according to M. An. Sun :: G. D. above L. Eq. Sun in Ap. and Perig. : Pres. Dif. to be added to the L. Eq. Sun in Ap. for the *Variation* required.

Hence, $\frac{\text{Pres. D. ☽ Oct}^{s}.}{240''}$ (= Multr.) × G. D. ☽ out of Octants = Pres. Dif. to be added to L. Equation.

Ex. *To find the Moon's Pres. Var. to* $0^s\ 25^\circ$ ☽ *à* ☉ and $3^s\ 26^\circ$ *Sun's M. An.?*

	L. Eq.	G. D.
$0^s\ 25^\circ$ ☽ à ☉	25′ 24″	184″
Propl Eq.	+ 2 11	×r. ,72
☽ Pres. Var. reqd.	27 35	368
		1288
		13|2,48
	Propl Eq.	+ 2′ 11″

MOON'S Greatest VARIATION in Octants of ☽ à ☉, from Apog. to Perigee ☉.

Arg. SUN'S M. ANOM.

☉ M. An.	greatest Variat. ☽ in Octants	Lo. Log. —	☉ M. An.
s °	′ ″		° s
0 0	33 4	0	0 12
6	33 5	3	24
12	33 7	7	18
18	33 10	14	12
24	33 14	22	6
1 0	33 19	33	0 11
6	33 27	50	24
12	33 35	68	18
18	33 44	87	12
24	33 54	100	6
2 0	34 4	130	0 10
6	34 16	155	24
12	34 28	180	18
18	34 41	208	12
24	34 54	235	6
3 0	35 8	264	0 9
6	35 22	292	24
12	35 35	319	18
18	35 49	347	12
24	36 2	374	6
4 0	36 15	400	0 8
6	36 27	423	24
12	36 38	445	18
18	36 48	465	12
24	36 58	485	6
5 0	37 6	500	0 7
6	37 13	514	24
12	37 18	524	18
18	37 22	531	12
24	37 24	535	6
6 0	37 25	537	0 6
☉ M. An.	greatest Variat. ☽ in Octants	— Lo. Log.	☉ M. An.

Constr. The above Eqns in *Oct.* of ☽ à ☉ incr. according to the Dif. of *Cubes* ☉ Dist. à ⊖, fr. 33′ 4″ Var. in Ap. to, 37 25 Var. in Per. ☉.

Ex. *Of the foregoing Case.*

	L. L.
☽ à ☉ 25° 25′ 24″ Eq.	0.3733
$3^s\ 26^\circ$ ☉ M. An.	—382
☽ Pres. Var. 27′ 44″	3351

according to this *Hypothesis.*

Accordg to Sir *I. Newton*, G. Var. in ☽ *Oct.* is in Sq. of ☽'s Syn. rev. dirly, & Cub. ☉ à ⊖, inversly. } Octs. ☽ à ☉. ☉ Ap. 33′ 14″ ☉ Per. 37 11 Variation.

Inversly, accng to *Cubes* of ☉ Dis. à ⊖, M. Dis. 35′ 10″. } Octs ☽ à ☉. ☉ Ap. 33′ 26″ ☉ Per. 37 1 Variation.

Accordg. to Dr. *Halley*. } ☉ Ap. 33 16 ☉ Per. 37 14 Var.

SUPPLEMENTAL LUNAR TABLES.

OR, V. EQUATION of the MOON's Mean VARIATION. According to the NEWTONIAN THEORY.

☉ in Octants, or at a Mean Dist. à ⊖.

Arg. MOON *Equated* from the SUN.

☽ à ☉. °	Sig. 0. 6. + ′ ″	Dif. ′ ″	Sig. 1. 7. + ′ ″	Dif. ′ ″	Sig. 2. 8. + ′ ″	Dif. ′ ″	☽ à ☉. °
0	0 0	1 14	30 27	0 36	30 27	0 38	30
1	1 14	1 13	31 3	0 33	29 49	0 40	29
2	2 27	1 13	31 36	0 31	29 9	0 32	28
3	3 40	1 14	32 7	0 29	28 27	0 44	27
4	4 54	1 12	32 36	0 27	27 43	0 47	26
5	6 6	1 13	33 3	0 24	25 56	0 48	25
6	7 19	1 11	33 27	0 21	26 8	0 50	24
7	8 30	1 11	33 48	0 19	25 18	0 52	23
8	9 41	1 11	34 7	0 17	24 26	0 54	22
9	10 52	1 10	34 24	0 14	23 32	0 56	21
10	12 2	1 8	34 38	0 12	22 36	0 57	20
11	13 10	1 8	34 50	0 9	21 39	0 59	19
12	14 18	1 7	34 59	0 6	20 40	1 0	18
13	15 25	1 5	35 5	0 4	19 40	1 2	17
14	16 30	1 3	35 9	0 1	18 38	1 3	16
15	17 35	1 2	35 10	0 1	17 35	1 5	15
16	18 38	1 0	35 9	0 4	16 30	1 5	14
17	19 40	0 59	35 5	0 6	15 25	1 7	13
18	20 40	0 57	34 59	0 9	14 18	1 8	12
19	21 39	0 56	34 50	0 12	13 10	1 8	11
20	22 36	0 54	34 38	0 14	12 2	1 10	10
21	23 32	0 52	34 24	0 17	10 52	1 11	9
22	24 26	0 50	34 7	0 19	9 41	1 11	8
23	25 18	0 48	33 48	0 21	8 30	1 11	7
24	26 8	0 47	33 27	0 24	7 19	1 13	6
25	26 56	0 44	33 3	0 27	6 6	1 12	5
26	27 43	0 42	32 36	0 29	4 54	1 14	4
27	28 27	0 40	32 7	0 31	3 40	1 13	3
28	29 9	0 38	31 36	0 33	2 27	1 13	2
29	29 49		31 3	0 36	1 14	1 14	1
30	30 27		30 27		0 0		0
☽ à ☉.	— Sig. 11. 5.	Dif.	— Sig. 10. 4.	Dif.	— Sig. 9. 3.	Dif.	☽ à ☉.

N. B. *The above, or our 5th, is Sir* Isaac Newton's *6th Equation.*

Construction. As Rad. S. 35′ 10″ Gr. Mean Variation in *Octants* of ☽ à ☉, : S. 2. ☽ à ☉ (from next Quadrature or Sizygy) : S Pres. Mean Variation, as above, ☉ being in *Octants*, or at a Mean Distance from ⊖.

Ex. *To find the correct Variation to 7ˢ 24° Arg. of mean Variation, and 2ˢ 5° of Sun's M. An.?*

	Eq.	L. L.
Arg. 7ˢ 24°	33′ 27″	2538
Sun's M. An. 2ˢ 5°		0106 +
Cor. Var. reqᵈ.	32′ 39″ reqᵈ.	2644

LOGISTICAL LOGARITHMS, to be added to the L. L. of the Mean Variation for the L. Log. of the correct Variation.

Arg. SUN's Mean ANOMALY.

☉M. An. °	Sig. 0. L. L. +	Sig. 1. L. L. +	Sig. 2. L. L. +	Sig. 3. L. L. +	Sig. 4. L. L. +	Sig. 5. L. L. +	☉M. An. °
0	0.0242	0.0211	0.0125	0.0004	9.9880	9.9787	30
1	0.0242	0.0209	0.0121	0.0000	9.9876	9.9785	29
2	0.0242	0.0207	0.0118	9.9995	9.9872	9.9783	28
3	0.0242	0.0205	0.0114	9.9991	9.9868	9.9781	27
4	0.0242	0.0203	0.0110	9.9987	9.9865	9.9779	26
5	0.0242	0.0201	0.0106	9.9982	9.9861	9.9777	25
6	0.0241	0.0198	0.0102	9.9978	9.9858	9.9775	24
7	0.0241	0.0195	0.0098	9.9973	9.9854	9.9773	23
8	0.0240	0.0193	0.0695	9 9969	9.9851	9.9772	22
9	0.0240	0.0190	0.0091	9.9965	9.9847	9.9770	21
10	0.0239	0.0188	0.0087	9.9961	9.9844	9.9769	20
11	0.0238	0.0185	0.0083	9.9956	9.9840	9.9767	19
12	0.0237	0.0182	0.0079	9.9952	9.9837	9.9766	18
13	0.0236	0.0179	0.0075	9.9948	9.9833	9.9764	17
14	0.0235	0.0177	0.0071	9.9944	9.9830	9.9763	16
15	0.0234	0.0174	0 0067	9.9940	9.9827	9.9761	15
16	0.0233	0.0171	0.0063	9.9936	9.9824	9.9760	14
17	0.0232	0.0168	0.0059	9.9932	9.9822	9.9759	13
18	0.0231	0.0165	0.0055	9.9928	9.9818	9.9758	12
19	0.0230	0 0162	0.0050	9.9924	9.9815	9.4758	11
20	0.0229	0.0159	0.0046	9.9920	9.9812	9.9757	10
21	0.0227	0.0156	0.0042	9.9916	9.9809	9.9756	9
22	0.0226	0.0153	0.0038	9.9912	9.9807	9.9755	8
23	0.0224	0.0149	0.0033	9.9908	9.9804	9.9755	7
24	0.0223	0.0146	0.0029	9.9904	9.9802	9.9754	6
25	0.0220	0.0142	0.0025	9.9900	9.9799	9.9753	5
26	0.0219	0.0139	0.0021	9.9896	9.9797	9.9753	4
27	0.0217	0.0135	0.0016	9.9892	9.9794	9 9753	3
28	0.0215	0.0132	0.0012	9.9888	9.9792	9 9753	2
29	0.0213	0.0128	0.0008	9.9884	9.9789	9.9753	1
30	0.0211	0.0125	0.0004	9.9880	9 9787	9.9753	0
☉M. An.	+ L. L. Sig. 11.	+ L. L. Sig. 10.	+ L. L. Sig. 9.	+ L. L. Sig. 8.	+ L. L. Sig. 7.	+ L. L. Sig. 6.	☉M. An.

CONSTRUCTION. As *greatest* M. Variation 35′ 10″, ☽ in Octants à ☉, and ☉ in Octants or at a Mean Dist. à ⊖ : Present M. Variation, ☉ being in Octants :: greatᵗ. Variation ☽ in Octants of ☉, correspondent to the ☉ M. Anomaly : Present Variation required.

Hence. $\frac{\text{P. M. Var.} \times \text{P. G. Var. ☉ in Octs.}}{35' \, 10''} =$ Pr. true Var. And Hence + L. L. Pres. G. Var. in Octs. — L. L. 35′ 10″ = L. L. to be added to, or connected with, the L. L. of the present M. Variation, for L. L. of present *Correct Variation*, required.

SUPPLEMENTAL LUNAR TABLES.

V. EQUATION, or Moon's Variation. According to the *Horroxian* Theory.

Arg. MOON from the SUN.

☽ à ☉	Sig. 0. 6 + ′ ″	Dif. ′ ″	Sig. 1. 7 + ′ ″	Dif. ′ ″	Sig. 2. 8 + ′ ″	Dif. ′ ″	☽ à ☉
°							°
0	0 0	1 20	32 54	0 39	32 54	0 41	30
1	1 20	1 19	33 33	0 36	32 13	0 43	29
2	2 39	1 20	34 9	0 33	31 30	0 45	28
3	3 59	1 19	34 42	0 31	30 45	0 48	27
4	5 18	1 18	35 13	0 29	29 57	0 50	26
5	6 36	1 18	35 42	0 27	29 7	0 53	25
6	7 54	1 17	36 9	0 23	28 14	0 54	24
7	9 11	1 17	36 32	0 20	27 20	0 56	23
8	10 28	1 16	36 52	0 18	26 24	0 58	22
9	11 44	1 16	37 10	0 15	25 26	1 1	21
10	13 0	1 14	37 25	0 13	24 25	1 2	20
11	14 14	1 13	37 38	0 10	23 23	1 3	19
12	15 27	1 13	37 48	0 7	22 20	1 5	18
13	16 40	1 11	37 55	0 4	21 15	1 7	17
14	17 51	1 9	37 59	0 1	20 8	1 8	16
15	19 0	1 8	38 0	0 1	19 0	1 9	15
16	20 8	1 7	37 59	0 4	17 51	1 11	14
17	21 15	1 5	37 55	0 7	16 40	1 13	13
18	22 20	1 3	37 48	0 10	15 27	1 13	12
19	23 23	1 2	37 38	0 13	14 14	1 14	11
20	24 25	1 1	37 25	0 15	13 0	1 16	10
21	25 26	0 58	37 10	0 18	11 44	1 16	9
22	26 24	0 56	36 52	0 20	10 28	1 17	8
23	27 20	0 54	36 32	0 23	9 11	1 17	7
24	28 14	0 53	36 9	0 27	7 54	1 18	6
25	29 7	0 50	35 42	0 29	6 36	1 18	5
26	29 57	0 48	35 13	0 31	5 18	1 19	4
27	30 45	0 45	34 42	0 33	3 59	1 20	3
28	31 30	0 43	34 9	0 36	2 39	1 19	2
29	32 13	0 41	33 33	0 39	1 20	1 20	1
30	32 54		32 54		0 0		0
☽ à ☉	— Sig. 11. 5	Dif.	— Sig. 10. 4	Dif.	— Sig. 9. 3	Dif.	☽ à ☉

CONSTRUCTION.

As Rad. : S. Double Argument, or 2. ☽ à ☉ :: 38′ 0″ Equation at Greatest : Present Equation, *required.*

Example. *To find the Equation for 26° Argument?*

2 × 26° = 52° . . Sine ,788 to Rad. 1.

Gr. Eq. 38′

6304
2364
29′,944

So for the Rest. 56″,64 Eq. requd.

N. B. The above Eqn. and 7th, correctd. being connected will form a compd. *Variation. See our 1st and 2d Var. foregoing: also* Mayer's *compound Var. following.*

The 6th, and 7th, Eqns. to the Right are improved in Exactness by varying them in the *inverse Ratio* of ☽ à ⊖, *or directly,* as the Moon's Hor. Parallax, supplied by the last Tables of Correction.

VI. EQUATION of the Moon, or 2d Equation of the Center. According to the *Newtonian* Theory.

Arg. ☽ à ☉ + ☽ Ap. à ☉ Ap.

Arg. pror.	S. 0/6 {+/— ′ ″	S. 1/7 {+/— ′ ″	S. 2/8 {+/— ′ ″	Arg. prop.
°				°
0	0 0	1 12	2 5	30
1	0 2	1 15	2 7	29
2	0 5	1 17	2 8	28
3	0 7	1 19	2 9	27
4	0 10	1 21	2 10	26
5	0 12	1 23	2 11	25
6	0 15	1 25	2 12	24
7	0 17	1 27	2 13	23
8	0 20	1 29	2 14	22
9	0 22	1 31	2 15	21
10	0 25	1 33	2 16	20
11	0 27	1 35	2 17	19
12	0 30	1 37	2 17	18
13	0 32	1 39	2 18	17
14	0 35	1 41	2 19	16
15	0 37	1 43	2 20	15
16	0 40	1 44	2 20	14
17	0 42	1 46	2 21	13
18	0 44	1 48	2 21	12
19	0 46	1 49	2 22	11
20	0 49	1 51	2 22	10
21	0 51	1 52	2 23	9
22	0 54	1 54	2 23	8
23	0 56	1 55	2 24	7
24	0 59	1 57	2 24	6
25	1 1	1 58	2 24	5
26	1 3	2 0	2 24	4
27	1 5	2 1	2 25	3
28	1 8	2 3	2 25	2
29	1 10	2 4	2 25	1
30	1 12	2 5	2 25	0
Arg. pror.	S 11/5 {—/+	S 10/4 {—/+	S. 9/3 {—/+	Arg. prop.

Argument above transforms to 2. ☽ à ☉ + ☉ *An.* — ☽ *An.* The above corrects the 1st Equation ☽'s Center, and is properly Sir *Isaac*'s 5th.

Construction. As Rad. : S. Pres. Argument from nearest *Sizygy* or *Quadrature* :: 2′ 25″ Equation at Greatest : Present Equation, *required.*

Example. *To find the Equation for 30° Argument?* 25″

As 1 Rad. : 2′,416 Gr. E. :: S. 30° = ,5

,5
: 1′,2080
12″ Eq. required. *So for the rest.*

N. B. Dr. *Gregory* (*Astr. p.* 568) erroneously gives 2′ 10″ for 2′ 25″ gr. Eqn above, with *contrary* Sigs. to those of Sir *Is. Newton* (see last *Edit. Princip. Prop.* 35. *B.* 3) and therefore,

The Dif. $\left\{\begin{matrix} + \; 2' \, 25'' \\ - \; 2 \;\; 10 \end{matrix}\right\} = \left\{\begin{matrix} + \\ - \end{matrix}\right\} 4' \, 35'' \left\{\begin{matrix} \text{Gr.} \\ \text{Error.} \end{matrix}\right.$

Which Error *Leadbetter* and *Dunthorne* have strictly followed. Dr. *Halley* misplaced this Equation to precede the 4th or *central* that it should follow, occasioning *Error* and Trouble to mend it by a Corrn. of the *Arg.* there misplaced.

VII. EQUATION of the Moon, or, 2d *Mean Variation.* According to *Gregory's Astronomy.* P. 569.

Argument. Moon from the Sun.

☽ à ☉	S. 0/6 {—/+ ′ ″	S. 1/7 {—/+ ′ ″	S. 2/8 {—/+ ′ ″	☽ à ☉
°				°
0	0 0	1 10	2 1	30
1	0 2	1 12	2 2	29
2	0 5	1 14	2 4	28
3	0 7	1 16	2 5	27
4	0 10	1 18	2 6	26
5	0 12	1 20	2 7	25
6	0 15	1 22	2 8	24
7	0 17	1 24	2 9	23
8	0 19	1 26	2 10	22
9	0 22	1 28	2 11	21
10	0 24	1 30	2 12	20
11	0 27	1 32	2 12	19
12	0 29	1 34	2 13	18
13	0 32	1 35	2 14	17
14	0 34	1 37	2 15	16
15	0 36	1 39	2 15	15
16	0 39	1 41	2 16	14
17	0 41	1 42	2 16	13
18	0 43	1 44	2 17	12
19	0 46	1 46	2 17	11
20	0 48	1 47	2 18	10
21	0 50	1 49	2 18	9
22	0 52	1 50	2 19	8
23	0 55	1 52	2 19	7
24	0 57	1 53	2 19	6
25	0 59	1 55	2 19	5
26	1 1	1 56	2 20	4
27	1 4	1 57	2 20	3
28	1 6	1 59	2 20	2
29	1 8	2 0	2 20	1
30	1 10	2 1	2 20	0
☽ à ☉	S 11/5 {+/—	S 10/4 {+/—	S. 9/3 {+/—	☽ à ☉

The above corrects 1st Variation.

Constr. As Rad. : S. Argt, or Pr. Dist. ☽ à ☉, :: 2′ 20″ Eq. at Greatest : the Present Equation,

For 30° Argt $\left\{\begin{matrix} \text{Gr. E. } 2',33 = 2' \, 20'' \\ \text{Sine } . \; . \; . \; 5 \end{matrix}\right.$

Eq. 1′,165 = 1′ 10″ req.

So for the rest.

The above Eqn. varies according to the Position of Moon and Sun's Aps.—When they are *together* 54″ add to, but when *opposite* subtr. fr. 2′ 20″ (the M. gr. Eqn. in Quadc. Moon à Sun) for the pres. Gr. Eqn. varying bet. the gr. 3′ 14″ and least Eqn. 1′ 26″. While the Moon's Ap. is also in Syzigies with the Sun — and consy. the *proper Arg.* = 0s and 6s Sun's An. *respectively.*

But in *Quad.* Sun à Moon's Ap. the Moon's Ap. and Sun's Ap. being also *together*, and consy. the proper Arg. = Sun's An. 3s or 9s, 50″ or 1′. (*see Greg.*)

SUPPLEMENTAL LUNAR TABLES.

CORRECTION of *Gregory's* VII. or 2d *Variation.*

Arg. SUN's true ANOMALY.

Sun's true An.	Gr. Eq. in Qua. ☽ à Sun.	×rs of Mean Var.	L. L. +	Sun's true An.
s °	′ ″			° s
0 0	1 26	,614	2166	0 12
6	1 26	,614	2166	24
12	1 27	,621	2066	18
18	1 28	,628	2016	12
24	1 31	,650	1871	6
1 0	1 32	,650	1823	0 11
6	1 36	,685	1638	24
12	1 41	,721	1418	18
18	1 43	,735	1333	12
24	1 46	,757	1208	6
2 0	1 51	,792	1008	0 10
6	1 56	,828	0816	24
12	2 1	,864	0633	18
18	2 6	,900	0457	12
24	2 13	,950	0223	6
3 0	2 20	1,000	0000	0 9
6	2 25	1,035	0153	24
12	2 30	1,071	0300	18
18	2 35	1,107	0442	12
24	2 43	1,164	0661	6
4 0	2 49	1,207	0818	0 8
6	2 54	1,243	1044	24
12	2 59	1,278	1068	18
18	3 4	1,314	1187	12
24	3 6	1,328	1234	6
5 0	3 9	1,350	1304	0 7
6	3 14	1,385	1417	24
12	3 14	1,385	1417	18
18	3 14	1,385	1417	12
24	3 14	1,385	1417	6
6 0	3 14	1,385	1417	0 6
Sun's true An.	Gr. Eq. in Qua. ☽ à Sun.	×rs of Mean Var.	— L. L.	Sun's true An.

Gr. Aſtron. p. 569. "Sub. fr. 2′ 20″ for gr. preſ. Eq."—But this is evidently a *Miſtake*; for as the Arg. is Sun's An. 3ˢ and 9ˢ will have 2′ 20″ Eq. as by Tab *above.*—And what Dr. *Gregory* farther ſays of the Moon and Sun's Apˢ. being oppᶜ in *Quadrature* alſo of Sun á Moon's Ap. Sir *Iſ. Newton* cannot tell the *Incr.* or *Decr.* for Want of Obⁿˢ is a *farther Miſtake*, and inconſiſtent with the Arg. Sun's An. *thus proved.*

☽ Ap. — Sun Ap = 0ˢ } by 1.
— ☽ Ap. + Sun Pl. = 0ˢ 6ˢ } Poſitⁿ.

Sum, ☉ Pl. — ☉ Ap. = ☉ An. = 0ˢ 6ˢ

So for the *other* Proof of the *ſame* Arg. by Poſition 2d and 3d. following of Gregory.

Conſtruction.

By inverſe *Ratio* of *Cubes* of Sun's Diſt. á ⊖, and Reſt like the following Tab. of Correction.

N. B. ¼ deducted fr. the following mean 2d Varⁿ. is the Varⁿ. *nearly* according to our Corrⁿ. of the Theory.

VII. EQUATION of the MOON, or Second Mean *Variation.* According to the *Newtonian* Theory.

Arg. Moon from the Sun.

☽ à ☉	S. 0 − / 6 +	S. 1 − / 7 +	S. 2 − / 8 +	☽ à ☉
°	′ ″	′ ″	′ ″	°
0	0 0	1 30	2 36	30
1	0 3	1 32	2 37	29
2	0 6	1 35	2 39	28
3	0 9	1 38	2 41	27
4	0 13	1 40	2 42	26
5	0 15	1 43	2 43	25
6	0 19	1 45	2 45	24
7	0 22	1 48	2 46	23
8	0 24	1 51	2 47	22
9	0 28	1 53	2 48	21
10	0 31	1 56	2 50	20
11	0 35	1 58	2 50	19
12	0 37	2 1	2 52	18
13	0 41	2 2	2 52	17
14	0 44	2 5	2 54	16
15	0 46	2 7	2 54	15
16	0 50	2 10	2 55	14
17	0 53	2 11	2 55	13
18	0 55	2 14	2 56	12
19	0 59	2 16	2 56	11
20	1 2	2 18	2 57	10
21	1 4	2 20	2 57	9
22	1 7	2 21	2 59	8
23	1 11	2 24	2 59	7
24	1 13	2 25	2 59	6
25	1 16	2 28	2 59	5
26	1 18	2 29	3 0	5
27	1 22	2 30	3 0	3
28	1 25	2 33	3 0	2
29	1 27	2 34	3 0	1
30	1 30	2 36	3 0	0
☽ à ☉	S. 11 + / 5 −	S. 10 + / 4 −	S. 9 + / 3 −	☽ à ☉

The above corrects the principal *Variation*, and is Sir *Iſaac*'s 7th.

CONST. As Rad. : S. Arg. or preſ. Diſt. Moon à Sun :: 3′ M. Gr. Eqⁿ : preſent Equation.

For { Gr. Eqⁿ. 3′,0
30° Arg. { Sine . . . . ,5

So for the Reſt. 1,5 = 1′ 30″ reqᵈ.

Ex. *To find the true 2d Variation to* 1ˢ 15° *Moon à Sun and* 3ˢ 24° *Moon's Ap. à Sun's Perigee.*

	Eq.
☽ á Sun.	7″
1ˢ 15° . . .	— 2′,11
	1,272 ×r. for 3ˢ 24° Arg.
	422
	1477
	422
	211
— 2′ 41″	2′,68392

Var. reqᵈ. . . 41″

By Logiſtical Logˢ.	L. L.
M. Eqⁿ. 2′ 7″	1,4525
Log. for Argument . .	— 1045
Var. reqᵈ. 2′ 41″ as before	1,3480

N. B. Gregory's 2d Variation is uſed in the ſame Manner.

CORRECTION of the 7th EQUATION, or 2d Mean *Variation.* According to Sir *Iſaac Newton.*

Arg. Moon's Ap. fr. Sun's Per.

☽ ap. à ☉'s Per.	Gr. Eq. in Qua. ☽ à Sun.	×rs of 2d M Var.	L. L. +	☽ ap. à ☉'s Per.
s °	′ ″			° s
0 0	1 0	,333	4772	0 12
6	1 0	,333	4772	24
12	1 2	,344	4629	18
18	1 6	,366	4358	12
24	1 11	,394	4040	6
1 0	1 16	,422	3745	0 11
6	1 23	,461	3362	24
12	1 31	,505	2963	18
18	1 40	,555	2553	12
24	1 49	,605	2179	6
2 0	2 0	,666	1761	0 10
6	2 11	,728	1380	24
12	2 23	,794	1000	18
18	2 35	,861	0650	12
24	2 47	,928	0326	6
3 0	3 0	1,000	0000	0 9
6	3 13	1,072	0303	24
12	3 25	1,139	0565	18
18	3 37	1,205	0812	12
24	3 49	1,272	1045	6
4 0	4 0	1,333	1249	0 8
6	4 10	1,388	1426	24
12	4 20	1,444	1579	18
18	4 29	1,494	1744	12
24	4 37	1,539	1872	6
5 0	4 44	1,578	1980	0 7
6	4 50	1,611	2071	25
12	4 54	1,633	2130	18
18	4 57	1,650	2175	12
24	4 59	1,661	2204	6
6 0	5 0	1,666	2218	0 6
☽ ap. à ☉'s Per.	Gr. Eq. in Qua. ☽ à Sun.	×rs of 2d M. Var.	— L. L.	☽ ap. à ☉'s Per.

CONSTRUCTION. (See *Principia*, p. 425. *Lat. Edit.* 1713.) As Rad : Ver. S. Moon's Ap. á Sun's Perigeon, in Conſequentia (= Ver. S. ☽'s Ap. — Sun's Ap. ± 6 Sigˢ.) :: 2′ : F, = 2′ × Ver. S. Arg. a 4th *Proportional* (making Rad. = 1.) And Rad. : S. Moon á Sun = *m* :: F + 1′ : F + 1′ × *m* (making Rad. 1.) = 2d *Var.* = 2′ × Ver. S. Arg. + 1′, the *gr. Eq. in Quadrature* Moon á Sun.

Now, 3′ Gr. M. Equat. in *Quad.* Moon á Sun : *Preſ.* M. Eq. in *Quad.* Moon á Sun according to Arg. :: preſ. Aſpect or Arg. Moon á Sun : preſent *true 2d Variation.*

Whence, $\frac{\text{P. G. Eq. in Quad.}}{3'}$ (= ×r.) × P. Eq. Moon á Sun = *true 2d Variation.* And L. L. Pr. G. Eq. *Dif.* L. L. 3′ = L. L. to be added to L. L. Pr. M. Eq. for the L. L. of the *true 2d Var.* — *N. B.* Sir *Iſ. Newton* aſſumes 2′ = P, and 1′ = Q in the above Propoⁿˢ, as near the Truth; but ſays P and Q ſhould be determᵈ. by Obⁿ. See Page aforeſaid of *Principia.*

Farther CORRECTION; according to the *Dif.* of the MOON's Diſtance from the EARTH and SUN.

Arg. M. An. ☽ à M. An. ☉.

A. ☽ à A. ☉.	0 + / 6 −	1 + / 7 −	2 + / 8 −	A. ☽ à A. ☉.
°	′ ″	′ ″	′ ″	°
0	0 0	0 20	0 35	30
1	0 1	0 20	0 35	29
2	0 2	0 21	0 36	28
3	0 2	0 21	0 36	27
4	0 3	0 22	0 36	26
5	0 4	0 23	0 37	25
6	0 4	0 23	0 37	24
7	0 5	0 24	0 37	23
8	0 6	0 24	0 37	22
9	0 6	0 25	0 38	21
10	0 7	0 26	0 38	20
11	0 7	0 26	0 38	19
12	0 8	0 27	0 38	18
13	0 9	0 27	0 38	17
14	0 9	0 28	0 38	16
15	0 10	0 28	0 39	15
16	0 11	0 29	0 39	14
17	0 11	0 29	0 39	13
18	0 12	0 30	0 39	12
19	0 13	0 30	0 39	11
20	0 13	0 31	0 39	10
21	0 14	0 31	0 39	9
22	0 15	0 32	0 40	8
23	0 15	0 32	0 40	7
24	0 16	0 33	0 40	6
25	0 17	0 33	0 40	5
26	0 17	0 34	0 40	4
27	0 18	0 34	0 40	3
28	0 19	0 34	0 40	2
29	0 19	0 35	0 40	1
30	0 20	0 35	0 40	0
A. ☽ à A. ☉.	− / 11 + / 5	− / 10 + / 4	− / 9 + / 3	A. ☽ à A. ☉.

Conſtruction.

As Rad. : Gr. Eqⁿ. 40″ :: S. Preſ. Arg. : Preſ. Equation.

EXAMPLE. *To find the Equation for* 30° *Arg.?*

As 1. (Rad.) : 40″ :: ,5 : (S. 30°) 20″ required.

So for the Reſt.

The Uſe of the above Equation is evident.

N. B. The above Argument tranſforms to ☽ à ☉ + ☉ Ap. à ☽ Ap. Or ☽ à ☉ — ☽ Ap. à ☉ Ap.

The Uſe of the foregoing Equation Tables in computing the Moon's Places is ſhewn by Examples farther on.

SUPPLEMENTAL LUNAR TABLES.

SECOND or Semiannual ÆQUATION of the MOON's NODE. According to the *Newtonian Theory*. With *Decimal Multipliers* and *Logistical Logarithms* to be applied to the greatest *Excesses* of *Reduction* and *Latitude* of ☽, for finding the present *Excesses* thereof, respectively, above the REDUCTION and LATITUDE for the *Least* Inclination of the *Lunar* Orbit (4° 59′ 35″.) Also the *Present Excesses* of Inclination above the *Least Inclination*.

Argument. SUN from the MOON's NODE.

⊙ à ☊	Sig. 0. 6. Æqua. ☊ +	Dif.	×rs to G. Ex^s. R^n & L^e	Lo. Log. for Red.Lat. +	G. Ex. above L. Inc.	Sig. 1. 7. Æqua. ☊ +	Dif.	×rs. to G. Ex. R^n & L^e	Lo. Log. for Red&Lat +	G. Ex^s. above L. Inc.	Sig. 2. 8. Æquat. ☊ +	Dif.	×rs. to G. Ex^s. R^n & L^e	Lo. Log. for Red&Lat +	G. Ex^s. above L. Inc.	⊙ à ☊
°	′ ″	′ ″			′ ″	′ ″	′ ″			′ ″	′ ″	′ ″			′ ″	°
0	0 0	3 3	1.0000	0000	17 45	76 39	1 34	,7530	1231	13 22	78 41	1 35	,2507	6008	4 27	30
1	3 3	3 3	1.0000	0000	17 45	78 13	1 31	,7380	1319	13 6	77 6	1 40	,2357	6276	4 11	29
2	6 6	3 2	,9990	0004	17 44	79 41	1 22	,7221	1414	12 49	75 26	1 46	,2206	6562	3 55	28
3	9 8	3 2	,9990	0004	17 44	81 3	1 17	,7061	1511	12 32	73 40	1 51	,2066	6849	3 40	27
4	12 10	3 1	,9972	0012	17 42	82 20	1 11	,6901	1610	12 15	71 49	1 57	,1925	7155	3 25	26
5	15 11	3 0	,9953	0020	17 40	83 31	1 5	,6742	1712	11 58	69 52	2 3	,1793	7463	3 11	25
6	18 11	2 59	,9925	0032	17 37	84 36	0 58	,6582	1816	11 41	67 49	2 7	,1662	7793	2 57	24
7	21 10	2 57	,9887	0049	17 33	85 34	0 53	,6422	1922	11 24	65 42	2 13	,1530	8150	2 43	23
8	24 7	2 55	,9840	0069	17 28	86 27	0 47	,6263	2032	11 7	63 29	2 18	,1399	8541	2 29	22
9	27 2	2 54	,9784	0094	17 22	87 14	0 40	,6094	2151	10 49	61 11	2 22	,1277	8938	2 16	21
10	29 56	2 52	,9718	0124	17 15	87 54	0 34	,5925	2273	10 31	58 49	2 27	,1164	9339	2 4	20
11	32 48	2 50	,9652	0153	17 8	88 28	0 28	,5756	2398	10 13	56 22	2 31	,1061	9742	1 53	19
12	35 38	2 47	,9577	0187	17 0	88 56	0 21	,5587	2528	9 55	53 51	2 36	,0957	10187	1 42	18
13	38 25	2 44	,9502	0221	16 52	89 17	0 14	,5418	2661	9 37	51 15	2 39	,0854	10683	1 31	17
14	41 9	2 42	,9427	0256	16 44	89 31	0 9	,5239	2807	9 18	48 36	2 43	,0760	11188	1 21	16
15	43 51	2 39	,9342	0295	16 35	89 40	0 1	,5061	2957	8 59	45 53	2 47	,0666	11760	1 11	15
16	46 30	2 35	,9258	0334	16 26	89 41	0 5	,4883	3105	8 40	43 6	2 50	,0582	12349	1 2	14
17	49 5	2 32	,9173	0374	16 17	89 36	0 11	,4695	3283	8 20	40 15	2 54	,0497	13030	0 53	13
18	51 37	2 29	,9080	0419	16 7	89 25	0 18	,4507	3461	8 0	37 22	2 56	,0422	13741	0 45	12
19	54 6	2 25	,8976	0468	15 56	39 7	0 25	,4319	3645	7 40	34 26	3 0	,0356	14475	0 38	11
20	56 31	2 21	,8864	0523	15 44	38 42	0 31	,4141	3829	7 21	31 26	3 1	,0300	15222	0 32	10
21	58 52	2 17	,8751	0579	15 32	88 11	0 38	,3962	4020	7 2	28 25	3 3	,0244	16123	0 26	9
22	61 9	2 12	,8629	0640	15 19	87 33	0 44	,3793	4209	6 44	25 22	3 6	,0197	17051	0 21	8
23	63 21	2 9	,8507	0702	15 6	86 49	0 51	,3624	4407	6 26	22 16	3 8	,0150	18232	0 16	7
24	65 30	2 3	,8376	0769	14 52	85 58	0 57	,3455	4615	6 8	19 8	3 9	,0113	19481	0 12	6
25	67 33	1 59	,8244	0838	14 38	85 1	1 4	,3286	4832	5 50	15 59	3 10	,0075	21242	0 8	5
26	69 32	1 55	,8113	0908	14 24	83 57	1 10	,3127	5049	5 33	12 49	3 11	,0046	23283	0 5	4
27	71 27	1 49	,7972	0984	14 9	82 47	1 16	,2967	5276	5 16	9 38	3 12	,0028	25502	0 3	3
28	73 16	1 44	,7831	1061	13 54	81 31	1 22	,2807	5516	4 59	6 26	3 13	,0009	30273	0 1	2
29	75 0	1 39	,7680	1145	13 38	80 9	1 28	,2657	5755	4 43	3 13	3 13	,0000	33263	0 0	1
30	76 39		.7530	1231	13 22	78 41		,2507	6008	4 27	0 0		,0000	33263	0 0	0
°	—	Dif.		+		—	Dif.		+		—	Dif.		+		°
⊙ a ☊	Æqua. ☊. Sig. 11. 5.		×rs to G. Ex^s R^n & L^e	Lo. Log. for Red.Lat.	G. Ex. above L. Inc.	Æqua. ☊. Sig. 10. 4.		×rs. to G. Ex^s. R^n & L^e	Lo. Log. for Red&Lat	G. Ex. above L. Inc.	Æqua. ☊. Sig. 9. 3.		×rs. to G. Ex^s. R^n & L^e	Lo. Log. for Red&Lat	G. Ex^s. above L. Inc.	⊙ à ☊

CONSTRUCTION of the above *Æquation* ☊. Com. Log.
As Const. N°. 59 (Sum of two Sides △) . . Co. 8.2291480
To Const. N°. 56 (their Dif.) 1.7481880
So Tan. ⊙ á ☊. Suppose 46° (½ Sum Opp. ∠s) 10.0151628
To Tan. Arch (½ Dif. ∠s) 44° 30′ 10″ 9.9924988
Deduct ½ Dif. fr. ½ Sum ∠s, rem. less ∠. } 1 29 41 the eq. ☊. *So for the rest.*

Or, As Sum *Forces* 115 (=59+56) Com Log. 7.9393022. co.
To their Dif. . 3 (=59−56) 0.4771213
So Radius 10.0000000
To S. Gr. Æq. ☊. 1°. 29 41″ 8.4164235
as before.

The Least Inclination ☽'s Orb with the Ecliptic being 4°. 59′ 35″ when ☊s are in the ⊙'s *Quadratures*, and greatest Inclination thereto 5°. 17′. 20″. When they are in Conjunction and Opposition with ⊙; it follows that the greatest Excess of Inclination is 17′ 45″. *See Prop* 35. *B.* 3. *Principia*, for Construction and Solution of the different Inclinations of ☽'s Orbit with Ecliptic.—Now, as 17′. 45″. Gr. Excess *Inclination* : Pres. Ex. thereof :: Gr. Ex^s. of *Reduction* and of *Latitude* : Pres. Ex. thereof, respectively, to be added to those for the Least Inclinaton ☽ Orbit, for the *Red.* and *Lat.* ☽, respectively required. Hence, $\frac{\textit{Pres. Exc. Inclin.}}{17' 45''}$ = Decim. ×r. And Lo. Log. Pres. Ex^t. Incl. — L. L. 17′45″ = Lo. Log. for the *Red.* and *Lat.* ☽; as above which ×rs. and Lo. Log. are found for min^s. above Deg^s ⊙ à ☊ by proportion of their Diff^s.

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES.

Reduction-Equation of the **Moon** from her Orbit to the **Ecliptic**. For the least and greatest *Inclination*; with the greatest Excess of *Reduction*.

☽ à ☊	*Arg.* of Lat. or *Moon* fr. *Node.* 2. Eq. Sig. 0. 6. *Red. Eq.* for L. In. −	D.	gr. ex. red +	Sig. 1. 7. *Red. Eq.* for L. In. −	D.	gr. ex. red +	Sig. 2. 8. *Red. Eq.* for L. In. −	D.	gr. ex. red +
°	′ ″	″	″	′ ″	″	″	′ ″	″	″
0	0 0	14	0	5 39	7	42	5 40	7	42
1	0 14	13	1	5 46	6	43	5 33	8	41
2	0 27	14	3	5 52	6	43	5 25	7	40
3	0 41	13	5	5 58	5	44	5 18	8	39
4	0 54	14	7	6 3	5	45	5 9	8	38
5	1 8	13	8	6 8	5	45	5 1	9	37
6	1 21	14	10	6 13	4	46	4 52	10	36
7	1 35	13	11	6 17	3	46	4 42	9	35
8	1 48	13	13	6 20	3	47	4 33	10	34
9	2 1	13	15	6 23	3	47	4 23	11	33
10	2 14	13	16	6 26	2	47	4 12	10	32
11	2 27	12	18	6 28	2	48	4 2	11	29
12	2 39	13	20	6 30	1	48	3 51	11	28
13	2 52	12	21	6 31	1	48	3 40	12	27
14	3 4	12	22	6 32	0	48	3 28	12	26
15	3 16	11	24	6 32	0	48	3 16	12	24
16	3 27	12	26	6 32	1	48	3 4	12	23
17	3 39	11	27	6 31	1	48	2 52	12	21
18	3 50	11	28	6 30	2	48	2 40	13	19
19	4 1	11	29	6 28	2	48	2 27	13	18
20	4 12	10	30	6 26	2	48	2 14	13	17
21	4 22	10	32	6 24	4	47	2 1	13	15
22	4 32	10	33	6 20	3	47	1 48	13	14
23	4 42	9	34	6 17	5	46	1 35	13	12
24	4 51	9	36	6 12	3	46	1 22	14	10
25	5 0	8	37	6 9	5	45	1 8	13	8
26	5 8	9	38	6 4	6	44	0 55	14	6
27	5 17	8	39	5 58	5	44	0 41	14	5
28	5 25	7	40	5 53	6	43	0 27	13	3
29	5 32	7	41	5 47	7	42	0 14	14	1
30	5 39		42	5 40		42	0 0		0
☽ à ☊.	+ *Red. Eq.* for Least Inclⁿ.	D.	+ gr. ex. red	+ *Red. Eq.* for Least Inclⁿ.	D.	+ gr. ex. red	+ *Red. Eq.* for Least Inclⁿ.	D.	+ gr. ex. red
	Sig. 11. 5.			Sig. 10. 4.			Sig. 9. 3.		

Latitude of the **Moon** for the least and greatest **Inclination** of her Orbit; (4° 59′ 35″, and 5° 17′ 20″) with the greatest Excess of Latitude.

Argument of Latitude, or Moon from Node. 2. Equated. Sig. 0. N. A. ☽'s Lat. for L. In.	Dif.	6. S. A. gr. ex. +	D.	Sig. 1. N. A. ☽'s Lat. for L. In.	Dif.	7. S. A. gr. ex. +	D	Sig. 2. N. A. ☽'s Lat. for L. In.	Dif.	8. S. A. gr. ex. +	D.	☽ à ☊.
° ′ ″	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	″	°
0 0 0	5 13	0 0	19	2 29 39	4 30	8 51	18	4 19 22	2 35	15 21	9	30
0 5 13	5 14	0 19	18	2 34 9	4 28	9 7	15	4 21 57	2 30	15 30	9	29
0 10 27	5 12	0 37	19	2 38 37	4 24	9 22	17	4 24 27	2 25	15 39	9	28
0 15 39	5 13	0 56	18	2 43 1	4 22	9 39	15	4 26 52	2 20	15 48	8	27
0 20 52	5 13	1 14	18	2 47 23	4 18	9 54	15	4 29 12	2 15	15 56	9	26
0 26 5	5 12	1 32	18	2 51 41	4 16	10 9	15	4 31 27	2 11	16 5	7	25
0 31 17	5 11	1 50	19	2 55 57	4 12	10 24	15	4 33 38	2 5	16 12	8	24
0 36 28	5 10	2 9	19	3 0 9	4 9	10 39	15	4 35 43	2 0	16 20	7	23
0 41 38	5 10	2 28	18	3 4 18	4 6	10 54	14	4 37 43	1 56	16 27	6	22
0 46 48	5 9	2 46	19	3 8 24	4 2	11 8	14	4 39 39	1 50	16 33	7	21
0 51 57	5 8	3 5	18	3 12 26	3 58	11 22	15	4 41 29	1 45	16 40	6	20
0 57 5	5 8	3 23	17	3 16 24	3 55	11 37	14	4 43 14	1 39	16 46	7	19
1 2 13	5 6	3 40	18	3 20 19	3 52	11 51	13	4 44 53	1 35	16 53	5	18
1 7 19	5 5	3 58	18	3 24 11	3 47	12 4	15	4 46 28	1 29	16 58	5	17
1 12 24	5 3	4 16	18	3 27 58	3 44	12 19	13	4 47 57	1 24	17 3	5	16
1 17 27	5 2	4 34	18	3 31 42	3 40	12 32	13	4 49 21	1 19	17 8	5	15
1 22 29	5 0	4 52	19	3 35 22	3 36	12 45	13	4 50 40	1 18	17 13	5	14
1 27 29	4 59	5 11	17	3 38 58	3 33	12 58	11	4 51 58	1 13	17 18	4	13
1 32 28	4 57	5 28	18	3 42 31	3 28	13 9	13	4 53 1	1 3	17 22	3	12
1 37 25	4 56	5 46	17	3 45 59	3 24	13 22	12	4 54 4	0 57	17 25	4	11
1 42 21	4 54	6 3	17	3 49 23	3 19	13 34	13	4 55 1	0 52	17 29	3	10
1 47 15	4 51	6 20	18	3 52 42	3 16	13 47	11	4 55 53	0 47	17 32	2	9
1 52 6	4 50	6 38	17	3 55 58	3 11	13 58	11	4 56 40	0 41	17 34	3	8
1 56 56	4 48	6 55	16	3 59 9	3 7	14 9	11	4 57 21	0 35	17 37	2	7
2 1 44	4 45	7 11	17	4 2 16	3 2	14 20	11	4 57 56	0 30	17 39	2	6
2 6 29	4 43	7 28	17	4 5 18	2 58	14 31	11	4 58 26	0 25	17 41	1	5
2 11 12	4 40	7 45	17	4 8 16	2 53	14 42	11	4 58 51	0 19	17 42	2	4
2 15 52	4 38	8 2	17	4 11 9	2 49	14 53	9	4 59 10	0 14	17 44	0	3
2 20 30	4 36	8 19	16	4 13 58	2 44	15 2	10	4 59 24	0 8	17 44	1	2
2 25 6	4 33	8 35	16	4 16 42	2 40	15 12	9	4 59 32	0 3	17 45	0	1
2 29 39		8 51		4 19 22		15 21		4 59 35		17 45		0
☽'s Lat. for least Inclin. S. D.	Dif.	+ gr. ex. Lat. N. D.	D.	☽'s Lat for least Inclin. S. D.	Dif.	+ gr. ex. Lat. N. D.	D.	☽'s Lat. for least Inclin. S. D.	Dif.	+ gr. ex. Lat. N. D.	D.	☽ à ☊.
Sig. 11.		5.		Sig. 10.		4.		Sig. 9.		3.		

Construction. As Rad. : S. twice Arg. Lat. or S. 2. ☽ à ☊ :: G. Red. Eq. : Present Red. Eq. *i. e.* in the present least and greatest Inclinations ☽ Orb. S. double Arg. (taking Rad. = 1) ×d into 6′,533 or 6′ 32″. and also into 7′,333 or 7′ 20″. respectively.

Ex. *To find the Reduction to* 1ˢ 21°. Arg. of *Lat. or* ☽ à ☊, *and* 1ˢ 17° ⊙ à ☊?
By Tab. foregoing ⊙ à ☊ 1ˢ 17° ... × r,4695
By Tab. above .. ☽ à ☊ 1ˢ 21° G. Ex. Rⁿ. 47″

☽ à ☊ Redⁿ 32865
1.21,—6′ 24″. L. Inclⁿ. 18780
+22 +22″,0665
Redⁿ—6 46 for pres. Iⁿ. reqᵈ. *So for the rest.* } By Lo. Log.. ⊙ à ☊ 1ˢ 17° L.L. 3283
Gr. Ex. Red. 47″ 1.8842
Proportional Reduction +22″ as above. 2.2125

N. B. Two of the first Figures of the ×r are sufficient to find the Reduction, which may always be taken out at Sight.

Const. As Rad. : S. pres. Inclin. :: S. pres. Arg. Lat. or S. ☽ à ☊ : S. pres. Lat. correspondent.

	Com. Log.
Ex. As Rad.	10.0000000
To S. least Inc. 4° 59′ 35″ .	8.9396939
So S. 30° Arg. ☽ à ☊ . . .	9.6989700
To S. 2° 29′ 39″ Lat. reqᵈ.	8.6386639. So for the rest.

Ex. *To find the Latitude* ☽ *to* 4ˢ 25° ☽ à ☊, the Argument of Latitude, and . . . . 9ˢ 23° ⊙ à ☊?
☽ à ☊ Lat. for least Inc. 9″
By Tab. above 4ˢ 25° . . . . . . 2° 51′ 41″ . . . . Gr. Ex. Lat. 10′,15
Proportional Latitude + 1 33 { By Tab. foregoing 9ˢ 23° ⊙ à ☊, ×r. } . . ,153
Lat. ☽ for Present Inclin. required 2° 53 14
3045
Tab. foregoing ⊙ à ☊. L.L.
By Lo. Log. . . . 9ˢ 23° 8150 5075
Tab. abo. 4ˢ 25° ☽ à ☊ Gr. Excess Lat. } 10′ 9″ 7717 1015
Proportional Lat. as before 1′ 33″ 1.5867 +1′,55295
33″

N. B. Three Figures of the Multiplier are generally sufficient to determine the *Moon's* Latitude.

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES.

The Horizontal Parallax of the Moon, in *Conjunction* or *Opposition* of the Sun and Moon. Also 1st *Part* of *Par.* out of *Sizygies*. To be *added* to the *apparent* for the true Altitude of the Moon; or *subtracted* from the apparent for the true Dist. of the Moon from the *Vertex*, and the *contrary*.

Horizontal Parallax to the *Middle State* of the *Moon's* Orbit, or Mean Eccentricity 55050 to Mean Dist. ⊙ à ⊖ 1000000. With the *Greatest Differences* of Parallax, *under* and *above* the Mean Parallax correspondent to the Greatest and Least Eccentricities, A (above) and U (under) the Mean Eccentricity.

Argument. True Anomaly of the MOON.

Tr An ☽	Sig. 0 Mean Hor. Pa. ☽.	G. D A. U	Sig. 1 Mean Hor. Pa. ☽.	G. D A. U	Sig. 2 Mean Hor. Pa. ☽	G. D A. U	Sig. 3 Mean Hor. Pa. ☽.	G. D A. U	Sig. 4 Mean Hor. Pa. ☽	G. D A. U	Sig. 5 Mean Hor. Pa. ☽.	G. D A. U	Tr An ☽
	+	−+	+	−+	+	−+	+	+−	+	+−	+	+−	
°	′ ″	″	′ ″	″	′ ″	″	′ ″	′ ″	′ ″	″	′ ″	″	°
0	54 4	35	54 29	31	55 38	15	57 12	4	58 47	25	59 56	40	30
1	54 4	35	54 31	30	55 41	15	57 16	5	58 49	25	59 57	40	29
2	54 4	35	54 32	30	55 44	14	57 19	5	58 52	26	59 59	40	28
3	54 4	35	54 34	29	55 47	14	57 22	6	58 55	27	60 1	40	27
4	54 4	35	54 36	29	55 50	14	57 26	6	58 57	27	60 2	40	26
5	54 5	35	54 38	28	55 53	13	57 29	7	59 0	28	60 3	41	25
6	54 5	35	54 40	28	55 56	12	57 32	8	59 3	29	60 5	41	24
7	54 5	35	54 42	28	55 59	12	57 36	8	59 5	29	60 6	41	23
8	54 6	35	54 44	27	56 2	11	57 39	9	59 8	30	60 7	42	22
9	54 6	35	54 46	27	56 5	11	57 42	10	59 11	30	60 9	42	21
10	54 6	35	54 48	27	56 8	10	57 46	10	59 13	30	60 10	42	20
11	54 7	35	54 50	26	56 11	9	57 49	11	59 15	31	60 11	43	19
12	54 8	35	54 52	26	56 14	8	57 52	12	59 18	31	60 12	43	18
13	54 8	35	54 55	26	56 17	7	57 55	13	59 20	31	60 13	43	17
14	54 9	34	54 57	25	56 20	6	57 58	14	59 23	32	60 14	43	16
15	54 10	34	54 59	25	56 23	5	58 1	15	59 26	33	60 15	43	15
16	54 11	34	55 1	24	56 26	5	58 4	15	59 28	33	60 15	43	14
17	54 12	34	55 4	23	56 30	5	58 7	15	59 30	34	60 16	44	13
18	54 13	34	55 6	22	56 33	4	58 10	16	59 33	34	60 17	44	12
19	54 14	34	55 9	22	56 36	4	58 14	17	59 35	34	60 17	44	11
20	54 15	33	55 11	21	56 40	3	58 17	18	59 37	35	60 18	44	10
21	54 16	33	55 13	20	56 43	2	58 20	19	59 39	36	60 19	44	9
22	54 17	33	55 16	20	56 46	2	58 23	19	59 41	36	60 19	44	8
23	54 18	33	55 19	19	56 50	1	58 26	20	59 43	37	60 19	45	7
24	54 20	33	55 21	19	56 53	0	58 29	21	59 45	37	60 20	46	6
25	54 21	33	55 24	19	56 57	1	58 32	21	59 47	37	60 20	46	5
26	54 22	32	55 27	18	57 0	2	58 35	22	59 49	38	60 20	46	4
27	54 24	32	55 30	18	57 3	2	58 38	23	59 51	39	60 21	46	3
28	54 26	32	55 33	17	57 6	3	58 41	23	59 52	39	60 21	46	2
29	54 28	31	55 35	16	57 9	4	51 44	24	59 54	40	60 21	46	1
30	54 29	31	55 38	15	57 12	4	58 47	25	59 56	40	60 21	46	0
	+	−+	+	−+	+	+	+	+−	+	+−	+	+−	
Tr An ☽	Mean Hor. Pa. ☽. Sig. 11	A. U G. D	Mean Hor. Pa. ☽. Sig. 10	A. U G. D	Mean Hor. Pa. ☽. Sig. 9	A. U G. D	Mean Hor. Pa. ☽. Sig. 8	A. U G. D	Mean Hor. Pa. ☽. Sig. 7	A. U G. D	Mean Hor. Pa. ☽. Sig. 6	A. U G. D	Tr An ☽

For Horizonl Parallax ☽, in Eccs above or under the Mean Eccy.

Ar. ⊙ à ☽ Ap. 1 eq.

⊙ à ☽ Ap	0. 6. ab.	1. 7. ab.	2. 8. un.	⊙ à ☽ Ap
°	×rs of G. D. Parallax.			°
0	1.	,57	,41	30
1	,99	,54	,44	29
2	,99	,51	,47	28
3	,99	,49	,50	27
4	,99	,46	,54	26
5	,98	,43	,57	25
6	,98	,40	,60	24
7	,97	,36	,63	23
8	,96	,33	,66	22
9	,96	,30	,68	21
10	,95	,27	,71	20
11	,94	,24	,74	19
12	,93	,20	,76	18
13	,91	,17	,78	17
14	,90	,14	,81	16
15	,89	,10	,83	15
16	,87	,07	,85	14
17	,85	,03	,87	13
18	,84	0	,89	12
19	,82	,03	,91	11
20	,80	,06	,92	10
21	,78	,10	,94	9
22	,76	,13	,95	8
23	,74	,17	,96	7
24	,72	,20	,97	6
25	,69	,24	,98	5
26	,67	,27	,98	4
27	,65	,31	,99	3
28	,62	,34	,99	2
29	,60	,38	,99	1
30	,57	,41	1.	0
	×rs of G. D. Parallax.			
⊙ à ☽ Ap	ab. 11. 5.	un. 10. 4.	un. 9. 3.	⊙ à ☽ Ap

Correction of the first Part of the Moon's Horizontal Parallax out of *Conjunction* and *Opposition*, or *Sizygies*. By Decim^l *Multipliers* and *Logistical Logarithms*.

Arg. Moon fr. Sun true.

☽ à ⊙ s °	Dec. ×rs.	Log. Logs	☽ à ⊙ ° s
6	−	+	6
0 0	,0000	0	0 12
3	,0001	½	27
6	,0002	1	24
9	,0006	2	21
12	,0007	3	18
15	,0008	4	15
18	,0014	6	12
21	,0019	8	9
24	,0022	10	6
27	,0031	13	3
1 0	,0036	16	0 5
7 3	,0044	19	27 11
6	,005	22	24
9	,0058	25	21
12	,0064	28	18
15	,0072	31	15
18	,0080	35	12
21	,0086	38	9
24	,0095	41	6
27	,01	44	3
2 0	,0108	47	0 4
8 3	,0114	50	27 10
6	,0120	52	24
9	,0125	55	21
12	,0130	57	18
15	,0133	58	15
18	,0136	60	12
21	,0139	61	9
24	,0142	62	6
27	,0142	62	3
3 0	,0145	63	0 3
9	−	+	9
☽ à ⊙	Dec. ×rs.	Log. Logs	☽ à ⊙

EXAMPLE. *To find the first Part of the Moon's Horizontal Parallax out of Conjunction and Opposition of the Sun and* Moon, *for* 4s 23° *True An.* 1s 24° ⊙ *à* ☽'s *Apog.* 1 *Equated, and* 3s *Arg.* Moon *à* Sun?

☽ An. — Hor. Par. — G. D.

By Tab. above 4s 23° . . 59′ 43″ . . + 37″ *above* Mean Parx for Gr. Eccy above M. Eccy.

— 7 — ,20 ×r for 1s 24° ⊙ à ☽'s Ap. Eccy. under M. Eccy.

1st Part of Hor. Parx ex. Syz. req. . 59′ 36″ . — 7″,40 Prop. Parallax to be sub. from the Mean Parallax.

N. B. Because ☽ — ☽ An. = ☽ Apogee.——Therefore ⊙ — ☽ + ☽ An. correct = ⊙ — ☽ Apogee correct; and when ⊙ à ☽, or ☽ à ⊙, (or which is the same ⊙ — ☽, or ☽ — ⊙) = o, or 6s, in *Conjunction* and *Opposition*, respectively, then Moon's An. true (or ☽ An. ± 6s) = Annual Argt. correct, or ⊙ à ☽'s Ap. true 1 the same of m. Dis.

Hence, it is observable, in *Syzygies*, or Conjunction and Opposition of Sun and Moon, that the *Argument* of Moon's true Anom. will be the same in Signs and Degrees as the Argt. for the ×r in *Tab.* of ⊙ à ☽'s Apog. supposing that Argument correct (the Dif. when the Argt. is ⊙ à ☽'s Ap. 1 Equated, being 2d Equation of ☽ Ap. with a contrary Sign, and Equation ☽'s Center, *connected* with the mean Anom. corrected, for nearly the true Anom. and the *contrary*). The Horizontal Parallax in a former Tab. is determined, according to the Argument of Moon's mean *Anomaly corrected*, and Argument of *Mean Evection* corrected, *(like the mean central and Evection Equations)* and the Correction of Parallax by Argument of Moon à Sun.

N. B. The *Horizontal Parallax* is to the apparent Diameter of the Moon, as 1 to ,55, or as 60 to 33. Hence the Const. Lo. Log. 2596, being added to the Lo. Log. of Hor. Par. will give the Lo. Log. of the Moon's apparent Diameter. Or ½ + 1/10 of that ½ of Hor Parx = Apt. Diam. Moon.

Constr. of Dec. ×rs from the Log. Logs.

Log. L. 63 . 59′, 8″

Or 1/6 5|9,1333, &c.

,98555, &c.

Compt to 1. ,0145—

D. ×r cort to L. Log. 63.

And so for the rest.

Ex.	L. L.
1. Pt 59′36″ Px ex. Syzy	+29
☽ à ⊙ 3s . .	+63
Px. out of Syzy 58′44″	+92

Or 59′ 36″ = 59′,6

,— 52 . . ,0145 ×r.

reqd. 58 44 — 2980

[cort Parx. — 2384

596

,86420

52″

SUPPLEMENTAL LUNAR TABLES.

The ECCENTRICITIES of the MOON, and Difference of those *Eccentricities* from the Mean Eccentricity 55237, the *Greatest* being 66854, and Least 43619; according to *Horrox*, or *Flamstead*. With the Difference of Eccentricities from the Mean 55050; according to Sir *Isaac Newton*, Rad. or Mean Dist. ☽ à ⊖ being 1000000.

Argument. SUN from the MOON's APOGEE; or Sun's true Pl. — m. Pl. ☽ Ap. 1 Equated.

☉ à ☽ Ap.	Sig. 0. 6 Eccentr^s. ☽ Orb. *Horrox.*	Differ^e. from the Mean.	Diff. Ecc^s fr. Mean. *Newton.*	Sig. 1. 7 Eccentr^s. ☽ Orb. *Horrox.*	Diff. from the Mean.	Diff. Ecc^s fr. Mean. *Newton.*	Sig. 2. 8 Eccentr^s. ☽ Orb. *Horrox.*	Diff. from the Mean.	Diff. Ecc^s fr. Mean *Newton.*	☉ à ☽ Ap.
°		above	above		above	above.		under.	under.	°
0	66854	11617	11732	61045	5808	6708	49429	5808	4827	30
1	66847	11610	11726	60691	5459	6388	49082	6155	5213	29
2	66826	11589	11708	60330	5093	6060	48741	6496	5594	28
3	66791	11554	11679	59962	4725	5725	48408	6829	5969	27
4	66741	11504	11638	59589	4352	5382	48085	7152	6337	26
5	66678	11441	11585	59210	3973	5033	47769	7468	6698	25
6	66600	11363	11520	58827	3590	4677	47463	7774	7051	24
7	66509	11272	11444	58439	3202	4315	47167	8070	7396	23
8	66404	11167	11356	58047	2810	3947	46880	8357	7731	22
9	66286	11049	11257	57652	2415	3574	46604	8633	8058	21
10	66154	10917	11146	57254	2017	3195	46337	8900	8373	20
11	66008	10771	11024	56854	1617	2811	46082	9155	8678	19
12	65850	10613	10891	56451	1214	2432	45838	9399	8973	18
13	65679	10442	10746	56047	810	2031	45606	9631	9253	17
14	65495	10258	10590	55642	405	1636	45385	9852	9522	16
15	65298	10061	10423	55237	± 0	1237	45176	10061	9778	15
16	65089	9852	10246	54832	405	835	44979	10258	10020	14
17	64868	9631	10058	54427	810	431	44794	10443	10248	13
18	64636	9399	9859	54023	1214	+ 24	44623	10614	10461	12
19	64392	9155	9650	53620	1617	— 384	44466	10771	10659	11
20	64137	8900	9430	53220	2017	792	44320	10917	10841	10
21	63870	8633	9200	52822	2415	1202	44188	11049	11007	9
22	63594	8357	8960	52427	2810	1611	44070	11167	11157	8
23	63307	8070	8711	52035	3202	2020	43965	11272	11290	7
24	63011	7774	8452	51647	3590	2428	43874	11363	11406	6
25	62705	7468	8183	51264	3973	2835	43796	11441	11505	5
26	62389	7152	7906	50885	4352	3240	43733	11504	11586	4
27	62066	6829	7619	50512	4725	3642	43683	11554	11649	3
28	61733	6496	7323	50144	5093	4041	43648	11589	11694	2
29	61392	6155	7020	49783	5454	4436	43627	11610	11722	1
30	61045	5808	6708	49429	5808	4827	43619	11618	11731	0
		above	above		under.	under.		under.	under	
☉ à ☽ Ap.	Eccentr^s. ☽ Orb. *Horrox.* Sig. 11. 5	Diff. from Mean.	Diff. Ecc^s fr. Mean. *Newton.*	Eccentr^s. ☽ Orb. *Horrox.* Sig. 10. 4	Diff. from Mean.	Diff. Ecc^s fr. Mean. *Newton.*	Eccentr^s. ☽ Orb. *Horrox.* Sig. 9 3	Diff. from Mean.	Diff. Ecc^s fr. Mean. *Newton.*	☉ à ☽ Ap.

CONSTRUCTION *of the Eccentricities of the Moon's Orbit.* According to Sir *Isaac Newton.*

As S. 2d Equation ☽ Ap. : ½ Diff. between the greatest and least Eccentricity 11731½ : : S. Double annual Argument, ☽'s Ap. Or S. 2. ☉ à ☽'s Ap. : Present Eccentricity.

N. B. The Eccentricity is *Greatest* when Apog. ☽ is in Sun's *Syzygies*, and *Least* when in the Quadratures.—These and other *Inequalities* of the Moon's Motion are augmented and diminished in the *Triplicate* Proportion of the Sun's apparent Diameter. And, moreover, the Moon's VARIATION is farther *augmented* or *diminished* in the duplicate Proportion of the Time between the *Quadratures.*—Though in Astronomical Computations this last Inequality is commonly thrown into and confounded with the Equation of the Moon's Center. See *Principia, Prop.* 22. B. 3.

SUPPLEMENTAL LUNAR TABLES.

EQUATION of the *Mean elliptic Equation* of the MOON's CENTER to that *Mean*, according to *Ward's Hypothesis*.

Argument. MOON's Equated Anomaly.

☽ Eqd. An.	Sig. 0 + ′	″	Sig. 1 + ′	″	Sig. 2 + ′	″	Sig. 3 + ′	″	Sig. 4 − ′	″	Sig. 5 − ′	″	☽ Eqd. An.
0	0	0	2	6	2	22	0	23	2	6	2	26	30
1	0	5	2	9	2	19	0	17	2	11	2	23	29
2	0	9	2	11	2	18	0	11	2	14	2	20	28
3	0	14	2	14	2	16	0	6	2	17	2	18	27
4	0	20	2	17	2	13	0 ±	1	2	19	2	12	26
5	0	24	2	19	2	10	0	4	2	21	2	9	25
6	0	28	2	20	2	8	0	10	2	25	2	7	24
7	0	33	2	22	2	5	0	15	2	28	2	2	23
8	0	38	2	25	2	2	0	21	3	30	1	59	22
9	0	44	2	25	1	59	0	27	2	33	1	55	21
10	0	49	2	27	1	55	0	32	2	33	1	50	20
11	0	53	2	29	1	51	0	38	2	36	1	46	19
12	0	57	2	29	1	47	0	44	2	37	1	41	18
13	1	2	2	30	1	43	0	49	2	38	1	37	17
14	1	7	2	31	1	40	0	53	2	39	1	32	16
15	1	10	2	33	1	36	0	59	2	40	1	26	15
16	1	15	2	33	1	32	1	6	2	41	1	21	14
17	1	19	2	33	1	27	1	8	2	41	1	16	13
18	1	23	2	33	1	24	1	13	2	41	1	11	12
19	1	27	2	33	1	18	1	19	2	41	1	5	11
20	1	31	2	33	1	14	1	25	2	40	0	59	10
21	1	36	2	32	1	9	1	29	2	41	0	54	9
22	1	39	2	31	1	4	1	34	2	39	0	47	8
23	1	43	2	31	0	59	1	38	2	39	0	41	7
24	1	48	2	31	0	54	1	43	2	38	0	37	6
25	1	50	2	29	0	49	1	47	2	36	0	31	5
26	1	53	2	28	0	45	1	52	2	36	0	25	4
27	1	57	2	28	0	39	1	56	2	33	0	18	3
28	1	59	2	25	0	34	1	59	2	30	0	12	2
29	2	4	2	24	0	29	2	3	2	28	0	6	1
30	2	6	2	22	0	23	2	6	2	26	0	0	0
☽ Eqd. An.	+ Sig. 11		+ Sig. 10		+ Sig. 9		− Sig. 8		− Sig. 7		− Sig. 6		☽ Eqd. An.

Note. The following EXAMPLES belong to Page 81.

CONSTRUCTION of the *Constant Logarithms*, in the following TABLE.

EXAMPLE 1. *To find the Const. Log. for 55321 Eccentricity?*

As Aph. Dist. : Perih. Dist. :: T. ½ corrd or Eqd Anomaly (taken for the M. An.) : T. ½ True An. By *Bullialdus*'s Corrn of *Ward*'s Hypoth.

Hence, $\frac{\text{Perih. Dist.}}{\text{Aph. Dist.}}$ × T. ½ corrd An. = T. ½ True An. Or, *Log. Per. D.* — *Log. Aph. D.* (= *Const. Log.*) + *Log. T.* ½ *cor. An.* = *Log. T.* ½ *True Anomaly*, required: Whence the Eq. ☽ Center. See following Pages.

	Nos.	Com. Logs.
Length Sem. Transv. =	1000000	
Eccentricity	+55321 —	
Aph. Dist.	1055321	6.0233845 —
Perih. Dist.	944679	5.9752842 sr.
Const. Log. (*nearly as above*) reqd		9.9518997 rem. *So for the rest.*

EXAMPLE 2. *Required from Tab. the Const. Log. for Equation ☽ Center, correspondent to Annual Argument*, or 7s 17° 23′ 34″ ☉ à ☽'s *Ap.?*

	Const. Log.			L. L.
For 7s 17° . .	9.951761	. . Exc. Ar.	23′ 34″	0.4059
	+139	1° more Dif.	5 54	1.0073
Const. Log. required	9.951900	+354 Parts =		
		+139 Parts +	2′ 19″	1.4132

By Logistical Log.			L. L.
Exc. Argt		23′ 34″	0.4059
For 1° Dif. . .	—407 =	6 47	0.9467
Proporl. Dif.	—160 =	2 40	1.3526
required.			

Construction of Eccentricity. As S. 2d Eq. Apogee (p. 63) : ½ Dif. between greatest and least Eccentricity = 11731½ :: S. double ☉ à ☽ Ap. : S. Present Eccentricity required.

EXAMPLE 3. *To find the Eccentricity for 2s 10°, Argument of ☉ à ☽ Ap.?*

	Com. Log.
½ Dif. bet. G. and L. Eccy 11731½	4.0693368
Argt. S. 2s 10° doub. = 140° or 40°	9.8080675
And (*from above*) as Eccy : Doub. Argt ☉ à ☽ Ap. :: 11731½ : Secd Eqn ☽ Ap. . . . S. 9° 17′ 50″, 2d Eq. Apog.	0.7916770 co.
Eccentricity 46676 required	4.6690813

IT having been observed that the Moon's Place come *nearest* by solving Moon's central Eq. according to *Ward's Hypothesis*, this Eq. may be applied, as a *Medium of Correction*, by those who chuse to try it in Quadr. Moon à Sun. Which Eqn. and Sigs. above being also *connected* with the Sigs. and Quantities of Mr. *Brent's Reduction* of *Ward*'s mean to the *true elliptic Equation* (*see his Compendious Astronomer*) will give the proper Reduction of the mean elliptic to the true elliptic Equation.

EXAMPLE 4. *Required from Tab. p. 81. the Eccentricity, for 7s 17° 23′ 34″, Annual Argument?*

	Excency	Dif.
An. Ar. 7s 17°	55481	—407 for 60′
	—160	
Eccentricity	55321	required

23′ 34″ = 23′,56
×407
16492
94240
6)958|8,92(159,8 Propl. Dif.

Or thus, 23′,56 Excess of Argument.
6,78 Multiplier for 407. Dif. Eccentricity.
18848
16492
14136
159,7368 as before.

DIFFERENT METHODS

Of Computing the

ELLIPTIC EQUATION of the MOON's CENTER.

SUPPLEMENTAL LUNAR TABLES.

CONSTANT LOGARITHMS, *correspondent to the* Different ECCENTRICITIES of the MOON's *Orbit*, and Sem. Transverse 1000000. For taking out the EQUATION or CORRECTION to Half the *Moon's Equated* ANOMALY in the *following Pages*, and thence to find the ELLIPTIC EQUATION of the MOON's CENTER.

Argument. SUN from the MOON's Apogee, or ☉ true Pl. — ☽ Ap. I. Equated.

☉ à ☽ Ap	Sig. o. 6. Con. Log. for Æq. ☽ Cent.	Dif.	Ecc. ☽ orb parts.	Dif. pts.	× rs of ex. of Ar	Sig. 1. 7. Con. Log. for Æq. ☽ Cent.	Dif.	Ecc. ☽ orb. parts.	Dif. pts.	× rs of ex. of Ar	Sig. 2. 8. Con. Log. for Æq. ☽ Cent.	Dif.	Ecc. ☽ orb. parts.	Dif. pts.	× rs of ex. of Ar	☉ à ☽ Ap
°																°
0	9,941912		66782			9,946292		61758			9,956339		50223			30
1	9,941917	5	66776	6	,1.	9,946571	279	61438	320	5,33	9,956675	336	49837	686	6,43	29
2	9,941932	15	66758	18	,3.	9,946857	286	61110	328	5,46	9,957007	332	49456	381	6,35.	28
3	9,941958	26	66729	29	,48	9,947149	292	60775	335	5,58	9,957333	326	49081	375	6,25.	27
4	9,941994	36	66681	41	,68	9,947448	299	60432	346	5,71	9,957653	320	48713	368	6,13	26
5	9,942040	46	66635	53	,89	9,947752	304	60083	349	5,81	9,957968	315	48352	361	6,01	25
6	9,942096	56	66570	65	1,08	9,948062	310	59727	356	5,93	9,958275	307	47999	353	5,88	24
7	9,942163	67	66494	76	1,26	9,948377	315	59365	362	6,03	9,958575	300	47654	345	5,75	23
8	9,942239	76	66406	88	1,46	9,948697	320	58997	368	6,14	9,958867	292	47319	335	5,58	22
9	9,942326	87	66307	99	1,65.	9,949023	326	58624	373	6,21	9,959151	284	46992	327	5,45	21
10	9,942422	96	66196	111	1,85.	9,949353	330	58245	379	6,31	9,959426	275	46677	315	5,25	20
11	9,942529	107	66074	122	2,03	9,949687	334	57861	384	6,4.	9,959691	265	46372	305	5,08	19
12	9,942645	116	65941	133	2,22	9,950025	338	57473	388	6,46	9,959946	255	46078	294	4,9.	18
13	9,942771	126	65796	145	2,41	9,950367	342	57081	392	6,53	9,960191	245	45797	281	4,68	17
14	9,942907	136	65640	156	2,6	9,950712	345	56686	395	6,58	9,960425	234	45528	269	4,48	16
15	9,943053	146	65473	167	2,78	9,951059	347	56287	399	6,65	9,960648	223	45272	256	4,26	15
16	9,943208	155	65296	177	2,95.	9,951409	350	55885	402	6,7.	9,960858	210	45030	242	4,03	14
17	9,943372	164	65108	188	3,13	9,951761	352	55481	404	6,73	9,961056	198	44802	228	3,8.	13
18	9,943545	173	64909	199	3,31	9,952115	354	55074	407	6,78	9,961242	186	44589	213	3,55.	12
19	9,943728	183	64700	209	3,48	9,952470	355	54666	408	6,8.	9,961414	172	44391	198	3,3.	11
20	9,943919	191	64480	220	3,66	9,952827	357	54258	408	6,8.	9,961573	159	44209	189	3,03	10
21	9,944120	201	64250	230	3,83	9,953183	356	53848	410	6,83	9,961717	144	44043	166	2,76	9
22	9,944329	209	64010	240	4,	9,953540	357	53439	409	6,81	9,961848	131	43893	150	2,5.	8
23	9,944546	217	63761	249	4,15.	9,953896	356	53030	409	6,81	9,961963	115	43760	133	2,21	7
24	9,944772	226	63502	259	4,31	9,954251	355	52622	408	6,8.	9,962064	101	43644	116	1,91	6
25	9,945006	234	63233	269	4,48	9,954605	354	52215	407	6,78	9,962150	86	43545	99	1,65.	5
26	9,945248	242	62956	277	4,61	9,954957	352	51810	405	6,75	9,962221	71	43464	81	1,35.	4
27	9,945498	250	62669	287	4,78	9,955307	350	51408	402	6,7.	9,962276	55	43401	63	1,05.	3
28	9,945755	257	62373	296	4,93	9,955655	348	51009	399	6,65	9,962315	49	43356	45	,75	2
29	9,946020	265	62070	303	5,05	9,955999	344	50614	395	6,58	9,962339	24	43328	28	,46	1
30	9,946292	272	61758	312	5,2	9,956339	340	50223	391	6,51	9,962347	8	43319	9	,15	0
☉ à ☽ Ap	Con. Log. for Æq. ☽ Cent.	Dif.	Ecc. ☽ orb.	Dif.	× rs of ex. of Ar	Con. Log. for Æq. ☽ Cent.	Dif.	Ecc. ☽ orb.	Dif.	× rs of ex. of Ar	Con. Log. for Æq. ☽ Cent.	Dif.	Ecc. ☽ orb.	Dif.	× rs of ex. of Ar	☉ à ☽ Ap
	Sig. 11. 5.					Sig. 10. 4.					Sig. 9. 3.					

SUPPLEMENTAL LUNAR TABLES.

EQUATION, or CORRECTION of half the Equated ANOMALY of the MOON, for finding, at once, the Elliptic Equation of the MOON'S CENTER.

Argument. MOON'S Equated ANOMALY; or ☽ 3 equated — Ap. 2 equated.

☽ eq. A. Lo °	Sig. 0. + 9.942 ′ ″	Sig. 0. + 9.947 ′ ″	Sig. 0. + 9.952 ′ ″	Sig. 0. + 7.957 ′ ″	Sig. 0. + 9.962 ′ ″	Sig. 1. + 9.942 ′ ″	Sig. 1. + 9.947 ′ ″	Sig. 1. + 9.952 ′ ″	Sig. 1. + 9.957 ′ ″	Sig. 1. + 9.962 ′ ″	Sig. 2. + 9.942 ′ ″	Sig. 2. + 9.947 ′ ″	Sig. 2. + 9.952 ′ ″	Sig. 2. + 9.957 ′ ″	Sig. 2. + 9.962 ′ ″	☽ eq. A. Lo °
0	0 0	0 0	0 0	0 0	0 0	1 42	1 25	1 9	0 55	0 43	1 52	1 33	1 15	1 0	0 46	30
1	0 4	0 3	0 3	0 2	0 2	1 44	1 27	1 11	0 57	0 44	1 51	1 31	1 14	0 59	0 46	29
2	0 8	0 7	0 5	0 4	0 3	1 46	1 28	1 12	0 58	0 45	1 49	1 30	1 13	0 58	0 45	28
3	0 12	0 10	0 8	0 6	0 5	1 48	1 30	1 14	0 59	0 46	1 47	1 28	1 11	0 57	0 44	27
4	0 16	0 13	0 11	0 9	0 7	1 49	1 31	1 15	1 0	0 46	1 45	1 26	1 10	0 56	0 43	26
5	0 20	0 16	0 13	0 11	0 8	1 51	1 33	1 16	1 1	0 47	1 43	1 25	1 8	0 54	0 42	25
6	0 24	0 20	0 16	0 13	0 10	1 53	1 34	1 17	1 1	0 48	1 40	1 23	1 7	0 53	0 41	24
7	0 28	0 23	0 19	0 15	0 12	1 54	1 35	1 18	1 2	0 48	1 38	1 21	1 5	0 52	0 40	23
8	0 31	0 26	0 21	0 17	0 13	1 56	1 36	1 19	1 3	0 49	1 36	1 19	1 4	0 50	0 39	22
9	0 35	0 29	0 24	0 19	0 15	1 57	1 37	1 20	1 4	0 49	1 33	1 17	1 2	0 49	0 38	21
10	0 39	0 33	0 27	0 21	0 17	1 58	1 38	1 20	1 4	0 50	1 30	1 14	1 0	0 47	0 36	20
11	0 43	0 36	0 29	0 23	0 18	1 59	1 39	1 21	1 5	0 50	1 28	1 12	0 58	0 46	0 35	19
12	0 46	0 39	0 32	0 25	0 20	2 0	1 40	1 22	1 5	0 51	1 25	1 9	0 56	0 44	0 34	18
13	0 50	0 42	0 34	0 28	0 21	2 0	1 40	1 22	1 5	0 51	1 22	1 7	0 54	0 42	0 32	17
14	0 54	0 45	0 37	0 30	0 23	2 1	1 41	1 22	1 6	0 51	1 19	1 4	0 52	0 41	0 31	16
15	0 57	0 48	0 39	0 32	0 24	2 1	1 41	1 23	1 6	0 51	1 16	1 2	0 50	0 39	0 30	15
16	1 1	0 51	0 42	0 33	0 26	2 2	1 41	1 23	1 6	0 51	1 12	0 59	0 47	0 37	0 28	14
17	1 4	0 54	0 44	0 35	0 27	2 2	1 41	1 23	1 6	0 51	1 2	0 56	0 45	0 35	0 27	13
18	1 8	0 57	0 46	0 37	0 29	2 2	1 42	1 23	1 6	0 51	1 5	0 53	0 43	0 33	0 25	12
19	1 11	0 59	0 48	0 39	0 30	2 2	1 41	1 23	1 6	0 51	1 2	0 50	0 41	0 31	0 24	11
20	1 14	1 2	0 51	0 41	0 32	2 2	1 41	1 23	1 6	0 51	1 58	0 47	0 38	0 29	0 22	10
21	1 18	1 4	0 53	0 42	0 33	2 1	1 41	1 22	1 5	0 50	0 55	0 44	0 35	0 27	0 20	9
22	1 21	1 7	0 55	0 44	0 34	2 1	1 40	1 22	1 5	0 50	0 51	0 41	0 33	0 25	0 19	8
23	1 24	1 9	0 57	0 46	0 36	2 0	1 40	1 21	1 4	0 50	0 47	0 38	0 30	0 23	0 17	7
24	1 26	1 12	0 59	0 47	0 37	1 59	1 39	1 21	1 4	0 50	0 44	0 35	0 28	0 21	0 16	6
25	1 29	1 14	1 1	0 49	0 38	1 58	1 38	1 20	1 3	0 49	0 40	0 32	0 25	0 19	0 14	5
26	1 32	1 17	1 3	0 50	0 39	1 57	1 37	1 19	1 3	0 49	0 36	0 28	0 22	0 17	0 12	4
27	1 34	1 19	1 4	0 52	0 40	1 56	1 36	1 19	1 2	0 48	0 32	0 25	0 20	0 15	0 11	3
28	1 37	1 21	1 6	0 53	0 41	1 55	1 35	1 18	1 1	0 48	0 28	0 22	0 17	0 12	0 9	2
29	1 39	1 23	1 7	0 54	0 42	1 54	1 34	1 17	1 1	0 47	0 24	0 19	0 14	0 10	0 7	1
30	1 42	1 25	1 9	0 55	0 43	1 52	1 33	1 15	1 0	0 46	0 20	0 15	0 11	0 8	0 6	0
☽ eq. An	+ Sig. 11.					+ Sig. 10.					+ Sig. 9.					☽ eq. An

CONSTRUCTION of the above *Table* and SOLUTION of the *Keplerian* PROBLEM. See *Laws of the Moon's Motion at the End of Vol. 2. Principia*, p. 58. Put t = Sem. Transf. of an elliptical Orbit; n = *Eccentricity*, c = Sem. Conj. and $r = \angle\ 57^\circ\ 17'\ 44''$: $48''' = 57^\circ$, 2957795 = *Radius*.

$$\left.\begin{array}{l} B = \angle = \frac{nn}{2tt} r\ ;\ E = \frac{c}{2t} B\ ;\ S = \frac{4n}{3c} \\ \text{being greatest Æquations.} \\ A = \angle \text{ of mean Anomaly given.} \end{array}\right\} \quad \left.\begin{array}{r} \text{Say Rad. : S. } \angle\ 2\,A :: B : b \\ \text{Rad. : S. } \angle\ 2\,\overline{A \pm 2b} :: E : e \\ \text{Cube Rad. : Cub. S. } \angle\ \overline{A \pm b} :: S : s. \end{array}\right\}$$

N. B. The small Æquat. b is always of the same Sign with the Æquat. e, and in planetary Orbits always near the double of that Æquat.

$$\text{Then } \angle \text{ of \textit{corrected} Mean Anomaly will be } \left\{\begin{array}{l} A + e + s \\ A - e + s \\ A + e - s \\ A - e - s \end{array}\right\} \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} \left\{\begin{array}{l} \text{Quadrants} \\ \text{from} \\ \textit{Aphelion.} \end{array}\right\} \begin{array}{l} \frac{1}{2} \times \overline{e + s} \\ \frac{1}{2} \times \overline{-e + s} \\ \frac{1}{2} \times \overline{e - s} \\ \frac{1}{2} \times \overline{-e - s} \end{array} \left\{\begin{array}{l} \textit{Correction,} \\ \text{or} \\ \textit{Æquat.} \\ \text{of } \frac{1}{2} \text{ Anomaly.} \end{array}\right.$$

The *corrected* Anomaly being known, say as *Aph. Dist.* : *Perih. Dist.* :: T. ½ *corrected An.* : T. ½ *true Anomaly.*
Whence the true Anomaly and the Æquation, in all the *Planetary Orbits*, are found.

Correction in very Eccentric Orbits.

The rays are *reciprocally* in the Square of the Velocity about the upper Focus or assumed Center of Motion. As the Rectangle of Distances fr. *Foci* : Rectangle Sem. Axes :: Difference between the Mean and assum'd Motion : Error of the assum'd ∠ at the *Upper Focus*.

SUPPLEMENTAL LUNAR TABLES.

EQUATION or CORRECTION of half the Equated ANOMALY of the MOON, for finding, at once, the Elliptic Equation of the MOON'S CENTER.

Argument. MOON'S Equated ANOMALY, or ☽ 3. equated — ☽ Ap. 2 equated.

☽ eq. An.	Sig. 3. +					Sig. 4. —					Sig. 5. —					☽ eq. An.
Log.	9.942	9.947	9.952	9.957	9.962	9.942	9.947	9.952	9.957	9.962	9.942	9.947	9.952	9.957	9.962	Log.
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 20	0 15	0 11	0 8	0 6	1 26	1 13	1 0	0 49	0 39	1 36	1 21	1 6	0 53	0 42	30
1	0 16	0 12	0 9	0 6	0 4	1 29	1 15	1 2	0 50	0 40	1 35	1 19	1 5	0 52	0 41	29
2	0 12	0 9	0 6	0 4	0 2	1 30	1 16	1 3	0 51	0 41	1 33	1 18	1 4	0 51	0 40	28
3	0 8	0 5	0 3	0 2	0 1	1 32	1 18	1 5	0 52	0 42	1 31	1 16	1 2	0 50	0 39	27
4	0 4	0 2	0 0	— 0	— 1	1 34	1 20	1 6	0 53	0 42	1 28	1 14	1 1	0 49	0 38	26
5	—	— 1	— 2	0 2	0 3	1 36	1 21	1 7	0 54	0 43	1 26	1 12	0 59	0 47	0 37	25
6	0 4	0 4	0 5	0 5	0 4	1 38	1 23	1 8	0 55	0 44	1 24	1 10	0 57	0 46	0 36	24
7	0 8	0 8	0 7	0 7	0 6	1 39	1 24	1 9	0 56	0 44	1 21	1 8	0 56	0 44	0 35	23
8	0 12	0 11	0 10	0 9	0 8	1 41	1 25	1 10	0 57	0 45	1 18	1 6	0 54	0 43	0 34	22
9	0 16	0 14	0 13	0 11	0 10	1 42	1 26	1 11	0 57	0 45	1 16	1 3	0 52	0 41	0 33	21
10	0 20	0 18	0 16	0 13	0 11	1 44	1 27	1 12	0 58	0 46	1 13	1 1	0 50	0 40	0 31	20
11	0 24	0 21	0 18	0 16	0 13	1 45	1 28	1 13	0 58	0 46	1 10	0 58	0 48	0 38	0 30	19
12	0 27	0 24	0 21	0 18	0 14	1 45	1 29	1 13	0 59	0 46	1 7	0 56	0 46	0 37	0 29	18
13	0 31	0 27	0 24	0 20	0 16	1 46	1 29	1 13	0 59	0 46	1 3	0 53	0 43	0 35	0 27	17
14	0 35	0 31	0 26	0 22	0 18	1 47	1 30	1 14	1 0	0 47	1 0	0 50	0 41	0 33	0 26	16
15	0 39	0 34	0 29	0 24	0 19	1 47	1 30	1 14	1 0	0 47	0 57	0 48	0 39	0 31	0 24	15
16	0 43	0 37	0 31	0 26	0 21	1 47	1 30	1 14	1 0	0 47	0 53	0 45	0 37	0 29	0 23	14
17	0 46	0 40	0 34	0 28	0 22	1 48	1 30	1 15	1 0	0 47	0 50	0 42	0 34	0 27	0 21	13
18	0 50	0 43	0 36	0 30	0 24	1 48	1 30	1 15	1 0	0 47	0 46	0 39	0 32	0 25	0 20	12
19	0 53	0 46	0 38	0 32	0 25	1 48	1 30	1 15	1 0	0 47	0 43	0 36	0 29	0 23	0 18	11
20	0 57	0 48	0 41	0 33	0 27	1 47	1 30	1 14	1 0	0 47	0 39	0 33	0 27	0 21	0 17	10
21	1 0	0 51	0 43	0 35	0 28	1 47	1 30	1 14	0 59	0 47	0 35	0 29	0 24	0 19	0 15	9
22	1 3	0 54	0 45	0 37	0 29	1 46	1 29	1 13	0 59	0 46	0 31	0 26	0 21	0 17	0 13	8
23	1 6	0 56	0 47	0 39	0 31	1 45	1 29	1 13	0 58	0 46	0 28	0 23	0 19	0 15	0 12	7
24	1 9	0 59	0 49	0 40	0 32	1 44	1 28	1 12	0 58	0 45	0 24	0 20	0 16	0 13	0 10	6
25	1 12	1 1	0 51	0 42	0 33	1 43	1 27	1 12	0 57	0 45	0 20	0 16	0 13	0 11	0 8	5
26	1 15	1 4	0 53	0 43	0 34	1 42	1 26	1 11	0 57	0 44	0 16	0 13	0 11	0 9	0 7	4
27	1 18	1 6	0 55	0 45	0 36	1 41	1 25	1 10	0 56	0 44	0 12	0 10	0 8	0 7	0 5	3
28	1 21	1 9	0 57	0 46	0 37	1 40	1 24	1 9	0 55	0 43	0 8	0 7	0 5	0 4	0 3	2
29	1 23	1 11	0 59	0 48	0 38	1 38	1 22	1 8	0 54	0 43	0 4	0 3	0 3	0 2	0 2	1
30	1 26	1 13	1 0	0 49	0 39	1 36	1 21	1 6	0 53	0 42	0 0	0 0	0 0	0 0	0 0	0
☽ eq. An.	± Sig. 8.					— Sig. 7.					— Sig. 6.					☽ eq. An.

Ex. *The Eccentricity being* 0,060 *and Mean An.* 30° *to find the Correction, or Equation of* ½ *M. Anom. and also the correct* Equation *of the* Orbit? B = 6′ 11″ 16‴ = ,103132°; Gr. E. = 3′ 5″ 15‴ = ,051463°; S = 29″ 45‴ = ,008267°—Now, *b* = 5′ 21″ 29‴ = ,0893°; *e* = 2′ 40″ 42‴ = ,04464°; *s* = 3″ 44‴ = ,00104°, [nearly according to Mr. *Machin*].

Hence, A + *e* + *s* = 30° 2′ 44″ 26‴ the Corrected Anomaly.

		Log.
The half	15° 1′ 22″ 13‴ Tang.	9.4287444 . . [1′ 22″ 13‴ Equation, or *Correction.*
For Eccentricity	,06 Const. Log.	9.9478220
	13° 23′ 13″ 15‴ . . Tan.	9.3765664
Double	26 46 26 30—	
	30	
Correct Equation . .	3° 13′ 33″ 30‴ *required. So for the rest.*	

EXAMP. *To find the* Moon's Central Equation *correspondent to* 1s 11° ☽ *Equated Anom. and* 2s 8° *Sun à* ☽ *Apogee?*

	Equ. An. ☽	
By *Tab.* p. 67. . . Argt. 1s 11° =	41° 0′ 0″	Equated Anomaly.
½	20 30 0	
Correction or Equation . . .	+ 59	Com. Logart.
Corrected Anom. T. . . .	20 30 59	9.5731163
By *Tab.* p. 81. . . . . Const. Log.		9.958867 for Eq. ☽ Center.
½ True Anom. T.	18 47 54	9.5319833
Doubled . . .	37 35 48 —, or deduct from Equd. Anomaly.	
Equation of ☽'s Center —	3 24 12 *required.*	

Eccentrs and Equations.				
Eccs. to Rad. 1.	E.	Dif.	S.	Dif.
	′ ″		″	
0.040	1 23		0	
0.045	1 45	22	13	4
0.050	2 09	24	17	4
0.055	2 36	27	23	6
0.060	3 08	30	30	7
0.065	3 38	32	38	8
0.070	4 14	36	47	9

The above Table, by Mr. *Machin.*

SUPPLEMENTAL LUNAR TABLES.

ELLIPTIC EQUATION of the MOON's CENTER in all *States* of Her *Variable Orbit:* From *Excentricity* 43319 to 66782; the *Mean Distance* being 1000000. According to the *Newtonian* Theory.

Argument. The MOON's Equated ANOMALY, Or Moon 3 Equated — Moon Ap. 2. Equated.

SIGN 0.

In. of Dc fr. M for +	☽ eq. An.	45000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	50000 Eq. ☽ —	Dif.	D.Eq. for D. 5000	55000 Eq. ☽ —	Dif.	D.Eq. for D. 5000	60000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	65000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	☽ eq. An	De of In. fr. M. for —
″	°	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	°	″
0	0	0 0 0		0 0	0 0 0		0 0	0 0 0		0 0	0 0 0		0 0	0 0 0		0 0	30	0
1	1	0 5 7	5 7	0 32	0 5 39	5 39	0 31	0 6 10	6 10	0 32	0 6 42	6 42	0 31	0 7 13	7 13	0 30	29	1
0	2	0 10 13	5 6	1 4	0 11 17	5 38	1 4	0 12 21	6 11	1 2	0 13 23	6 41	1 2	0 14 25	7 12	1 2	28	0
1	3	0 15 20	5 7	1 36	0 16 56	5 39	1 35	0 18 31	6 10	1 34	0 20 5	6 42	1 33	0 21 38	7 13	1 32	27	1
1	4	0 20 26	5 6	2 8	0 22 34	5 38	2 7	0 24 41	6 10	2 5	0 26 46	6 41	2 4	0 28 50	7 12	2 3	26	1
2	5	0 25 32	5 6	2 40	0 28 12	5 38	2 38	0 30 50	6 10	2 37	0 33 27	6 41	2 35	0 36 2	7 12	2 33	25	2
3	6	0 30 37	5 5	3 13	0 33 50	5 38	3 10	0 37 0	6 10	3 7	0 40 7	6 40	3 6	0 43 13	7 11	3 5	24	1
2	7	0 35 42	5 5	3 44	0 39 26	5 36	3 42	0 43 8	6 8	3 39	0 46 47	6 40	3 36	0 50 23	7 10	3 33	23	3
3	8	0 40 47	5 5	4 16	0 45 3	5 37	4 13	0 49 16	6 8	4 10	0 53 26	6 39	4 7	0 57 33	7 10	4 4	22	3
4	9	0 45 51	5 4	4 48	0 50 39	5 36	4 44	0 55 23	6 7	4 41	1 0 4	6 38	4 38	1 4 42	7 9	4 35	21	3
3	10	0 50 54	5 3	5 19	0 56 13	5 34	5 16	1 1 29	6 6	5 13	1 6 42	6 38	5 8	1 11 50	7 8	5 3	20	5
3	11	0 55 56	5 2	5 51	1 1 47	5 34	5 48	1 7 35	6 6	5 43	1 13 18	6 36	5 39	1 18 57	7 7	5 35	19	4
5	12	1 0 58	5 2	6 23	1 7 21	5 34	6 18	1 13 39	6 4	6 14	1 19 53	6 35	6 10	1 26 3	7 6	6 6	18	4
[illegible]	13	1 5 58	5 0	6 55	1 12 53	5 32	6 49	1 19 42	6 3	6 45	1 26 27	6 34	6 40	1 33 7	7 4	6 35	17	5
[illegible]	14	1 10 58	5 0	7 26	1 18 24	5 31	7 20	1 25 44	6 2	7 16	1 33 0	6 33	7 11	1 40 11	7 4	7 6	16	5
7	15	1 15 56	4 58	7 58	1 23 54	5 30	7 51	1 31 45	6 1	7 47	1 39 32	6 32	7 41	1 47 13	7 2	7 36	15	6
6	16	1 20 53	4 57	8 29	1 29 22	5 28	8 23	1 37 45	6 0	8 17	1 46 2	6 30	8 11	1 54 13	7 0	8 5	14	6
6	17	1 25 49	4 56	9 0	1 34 49	5 27	8 54	1 43 43	5 58	8 47	1 52 30	6 28	8 42	2 1 12	6 59	8 37	13	5
7	18	1 30 44	4 55	9 31	1 40 15	5 26	9 24	1 49 39	5 56	9 18	1 58 57	6 27	9 11	2 8 8	6 56	9 4	12	7
7	19	1 35 37	4 53	10 2	1 45 39	5 24	9 55	1 55 34	5 55	9 48	2 5 22	6 25	9 41	2 15 3	6 55	9 34	11	7
6	20	1 40 29	4 52	10 32	1 51 1	5 22	10 26	2 1 27	5 53	10 18	2 11 45	6 23	10 11	2 21 56	6 53	10 4	10	7
7	21	1 45 19	4 50	11 3	1 56 22	5 21	10 56	2 7 18	5 51	10 48	2 18 6	6 21	10 41	2 28 47	6 51	10 34	9	7
7	22	1 50 8	4 49	11 33	2 1 41	5 19	11 26	2 13 7	5 49	11 18	2 24 25	6 19	11 11	2 35 36	6 49	11 4	8	7
7	23	1 54 55	4 47	12 3	2 6 58	5 17	11 56	2 18 54	5 47	11 48	2 30 42	6 17	11 41	2 42 23	6 47	11 34	7	7
8	24	1 59 39	4 44	12 34	2 12 13	5 15	12 26	2 24 39	5 45	12 18	2 36 57	6 15	12 10	2 49 7	6 44	12 2	6	8
9	25	2 4 23	4 44	13 4	2 17 27	5 14	12 55	2 30 22	5 43	12 47	2 43 9	6 12	12 39	2 55 48	6 41	12 31	5	8
9	26	2 9 4	4 41	13 34	2 22 38	5 11	13 25	2 36 3	5 41	13 16	2 49 19	6 10	13 8	3 2 27	6 39	13 0	4	8
8	27	2 13 43	4 39	14 3	2 27 46	5 8	13 55	2 41 41	5 38	13 46	2 55 27	6 8	13 37	3 9 4	6 37	13 28	3	9
9	28	2 18 20	4 37	14 33	2 32 53	5 7	14 24	2 47 17	5 36	14 15	3 1 32	6 5	14 5	3 15 37	6 33	13 55	2	10
9	29	2 22 55	4 35	15 2	2 37 57	5 4	14 53	2 52 50	5 33	14 44	3 7 34	6 2	14 34	3 22 8	6 31	14 24	1	10
10	30	2 27 27	4 32	15 32	2 42 59	5 2	15 22	2 58 21	5 31	15 12	3 13 33	5 59	15 3	3 28 36	6 28	14 54	0	9
+	☽ eq. An	+ Eq. ☽. 45000	Dif.	5000 D.Eq.	+ Eq. ☽. 50000	Dif.	5000 D.Eq.	+ Eq. ☽. 55000	Dif.	5000 D.Eq.	+ Eq. ☽. 50000	Dif.	5000 D.Eq.	+ Eq. ☽. 65000	Dif.	5000 D.Eq.	☽ eq. An	—
5000 D.																		5000 D.

SIGN 11.

EXAMPLE I. *To find the* Moon's Central Equation *correspondent to* 2ˢ 8° *Sun à Moon's Ap. and* 1ˢ 11° *Moon Equated Anomaly, according to the* Newtonian *Theory?*

Eccentricity ☽ Orb. — Ecc. above 45000.

By *Tab.* p. 81. Argᵗ Sun à Moon Ap. 1 Equated gives 47319 . . . . 2319 doubled = 4638

Equation for Eccentricity 45000.

By *Tab.* p. 85. Argᵗ 1ˢ 11° ☽ Eq. An. — 3° 14′ 36″ . . . Excefs of Eqⁿ. for 5000 20′ 37″ = 20′,61

Pr. Equation . +9 33 fere — 4638

☽ Central Equation — 3 24 9 *correctly,* required. See p. 83. — 27828

92760

+9′,5539,18

Pr. Eq. 33″

Or Excˢ. Eccʸ. 23′ 19″ = 38′ 39″	L. L.	
	1910	
Excefs Eqⁿ . . . 20 37	4639	
500|0 = 83 20	1426	Conft.
Propˡ. Eq. reqᵈ. 9 34	7975	reqᵈ.

Rule. To L. L. 1426 Conft. Add L. L. Excefs Eccʸ. and L. L. Excefs Eqⁿ. . . Sum L. L. *Prop. Eq. to be added to the Central Eq. for the Excefs of Eccentricity above the laft.*

Cutting off 4 Fig. to the Right where the × ing Decˢ are cut off for 10000 Divifor.

For 10000 to doub. Excefs of Eccʸ. is the fame as 5000 to fingle Excefs of Ecc[illegible]ty.

Hence, the taking out of the Eccentricity of Moon's Orb. *(in* p. 81.*)* and then the Central Equation *(as above)* is [illegible] ily performed, either by Decimal Multipliers, or *Logiftical Logarithms,* including 2d Equation of the Moon's Apogee.

SUPPLEMENTAL LUNAR TABLES.

ELLIPTIC EQUATION of the MOON'S CENTER, according to the *Newtonian* Theory.

Argument. The MOON's Equated Anomaly, or ☽ 3 Equated — ☽ Ap. 2 Equated.

SIGN 1.

In. of Defr. M for +	☽ eq. An	45000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	50000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	55000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	60000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	65000 Eq. ☽. —	Dif.	D.Eq. for D. 5000	☽ eq. An	De of In. fr. M for —
	°	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	°	
10	0	2 27 27		15 32	2 42 59		15 22	2 58 21		15 12	3 13 33		15 3	3 28 36		14 54	30	9
9	1	2 31 58	4 31	16 0	2 47 58	4 59	15 51	3 3 49	5 28	15 41	3 19 30	5 57	15 31	3 35 1	6 25	15 21	29	10
11	2	2 36 25	4 27	16 30	2 52 55	4 57	16 19	3 9 14	5 25	16 9	3 25 23	5 53	15 59	3 41 22	6 21	15 49	28	10
11	3	2 40 51	4 26	16 58	2 57 49	4 54	16 47	3 14 36	5 22	16 37	3 31 13	5 50	16 27	3 47 40	6 18	16 17	27	10
12	4	2 45 13	4 22	17 27	3 2 40	4 51	17 15	3 19 55	5 19	17 5	3 37 0	5 47	16 55	3 53 55	6 15	16 45	26	10
11	5	2 49 34	4 21	17 54	3 7 28	4 48	17 43	3 25 11	5 16	17 33	3 42 44	5 44	17 22	4 0 6	6 11	17 11	25	11
11	6	2 53 51	4 17	18 22	3 12 13	4 45	18 11	3 30 24	5 13	18 0	3 48 24	5 40	17 50	4 6 14	6 8	17 40	24	10
10	7	2 58 6	4 15	18 49	3 16 55	4 42	18 39	3 35 34	5 10	18 27	3 54 1	5 37	18 17	4 12 18	6 4	18 7	23	10
12	8	3 2 18	4 12	19 17	3 21 35	4 40	19 5	3 40 40	5 6	18 55	3 59 35	5 34	18 43	4 18 18	6 0	18 31	22	12
12	9	3 6 27	4 9	19 44	3 26 11	4 36	19 32	3 45 43	5 3	19 21	4 5 4	5 29	19 11	4 24 15	5 57	19 1	21	10
12	10	3 10 33	4 6	20 11	3 30 44	4 33	19 59	3 50 43	5 0	19 47	4 10 30	5 26	19 37	4 30 7	5 52	19 27	20	10
12	11	3 14 36	4 3	20 37	3 35 13	4 29	20 25	3 55 38	4 55	20 14	4 15 52	5 22	20 3	4 35 55	5 48	19 52	19	11
11	12	3 18 36	4 0	21 3	3 39 39	4 26	20 52	4 0 31	4 33	20 40	4 21 11	5 19	20 28	4 41 39	5 44	20 16	18	12
13	13	3 22 32	3 56	21 30	3 44 2	4 23	21 17	4 5 19	4 48	21 6	4 26 25	5 14	20 54	4 47 19	5 40	20 42	17	12
12	14	3 26 26	3 54	21 55	3 48 21	4 19	21 43	4 10 4	4 45	21 31	4 31 35	5 10	21 19	4 52 54	5 35	21 7	16	12
12	15	3 30 16	3 50	22 20	3 52 36	4 15	22 8	4 14 44	4 40	21 56	4 36 40	5 5	21 45	4 58 25	5 31	21 34	15	11
13	16	3 34 2	3 46	22 46	3 56 48	4 12	22 33	4 19 21	4 37	22 21	4 41 42	5 2	22 10	5 3 52	5 27	21 59	14	11
14	17	3 37 45	3 43	23 11	4 0 56	4 8	22 57	4 23 53	4 32	22 47	4 46 40	4 58	22 33	5 9 13	5 21	22 19	13	14
11	18	3 41 25	3 40	23 34	4 4 59	4 3	23 23	4 28 22	4 29	23 10	4 51 32	4 52	22 58	5 14 30	5 17	22 46	12	12
11	19	3 45 1	3 36	23 58	4 8 59	4 0	23 47	4 32 46	4 24	23 34	4 56 20	4 48	23 23	5 19 43	5 13	23 12	11	11
12	20	3 48 34	3 33	24 22	4 12 56	3 57	24 10	4 37 6	4 20	23 58	5 1 4	4 44	23 46	5 24 50	5 7	23 34	10	12
13	21	3 52 2	3 28	24 46	4 16 48	3 52	24 33	4 41 21	4 15	24 21	5 5 42	4 38	24 10	5 29 52	5 2	23 59	9	11
11	22	3 55 27	3 25	25 8	4 20 35	3 47	24 57	4 45 32	4 11	24 44	5 10 16	4 34	24 33	5 34 49	4 57	24 22	8	11
13	23	3 58 47	3 20	25 32	4 24 19	3 44	25 19	4 49 38	4 6	25 7	5 14 45	4 29	24 56	5 39 41	4 52	24 44	7	11
11	24	4 2 5	3 18	25 53	4 27 58	3 39	25 42	4 53 40	4 2	25 29	5 19 9	4 24	25 18	5 44 27	4 46	25 7	6	11
11	25	4 5 18	3 13	26 15	4 31 33	3 35	26 4	4 57 37	3 57	25 51	5 23 28	4 19	25 40	5 49 8	4 41	25 29	5	11
12	26	4 8 27	3 9	26 37	4 35 4	3 31	26 25	5 1 29	3 52	26 13	5 27 42	4 14	26 2	5 53 44	4 36	25 51	4	11
12	27	4 11 32	3 5	26 58	4 38 30	3 26	26 46	5 5 16	3 47	26 35	5 31 51	4 9	26 23	5 58 14	4 30	26 11	3	12
13	28	4 14 32	3 0	27 20	4 41 52	3 22	27 7	5 8 59	3 43	26 55	5 35 54	4 3	26 44	6 2 38	4 24	26 33	2	11
11	29	4 17 29	2 57	27 39	4 45 8	3 16	27 28	5 12 36	3 37	27 16	5 39 52	3 58	27 5	6 6 57	4 19	26 54	1	11
13	30	4 20 21	2 52	28 0	4 48 21	3 13	27 47	5 16 8	3 32	27 36	5 43 44	3 52	27 26	6 11 10	4 13	27 15	0	11
+		+			+			+			+			+				—
5000 D	☽ eq. An	Eq. ☽. 45000	Dif.	5000 D.Eq.	Eq. ☽. 50000	Dif.	5000 D.Eq.	Eq. ☽. 55000	Dif.	5000 D.Eq.	Eq. ☽. 60000	Dif.	5000 D.Eq.	Eq. ☽. 65000	Dif.	5000 D.Eq.	☽ eq. An	5000 D

SIGN 10.

EXAMPLE II. *To find the Equation of the* Moon's Center *answerable to* 1ˢ 15° 20′ *Sun à* ☽ *Apog. and* 3ˢ 5° 44′ ☽ *equated Anomaly?*

By *Tab.* p. 81. Sun à ☽ Ap. 1. equᵈ 1 S. 15° 20′ gives . . Eccʸ. ☽ Orb. 56153 . . . . Eccʸ above 55000 1153 . . double = 2306

By *Tab.* p. 87. Argᵗ. 3ˢ 5° 44′ ☽ eqᵈ An. . . . . Equation for Eccʸ 55000. — 6° 18′ 5″ . Excess of Eqⁿ. for 5000 . . 34′ 28″ = 34′,46 } ×d.

Propˡ. Eqⁿ. +7 56

☽ Central Equation correctly . . . —6 26 1 reqᵈ. See p. 96.

	Constant	L. L.
		1426+
Excess Eccʸ	19′ 13″	4945+
Excess Eccʸ	34 28	2408+
Propˡ. Eqⁿ.	7 56 *as before.*	.8779

The same *Rules* to be observed in other Cases.

13836
9224
9224
6918

Product *cutting off 4 Decimals, besides the multiplying Decimals.* +7′,9464,76
56″

SUPPLEMENTAL LUNAR TABLES.

IV. ELLIPTIC EQUATION of the MOON's *Center*. According to the *Newtonian Theory*.

Argument. The MOON's Equated Anomaly, Or ☽ 3 Equa. — Ap. 2 Equated.

SIGN 2.

In of D fr. M for + ″	☽ eq A. °	45000 Eq. ☽. — ° ′ ″	Dif. ′ ″	D. Eq for D. 5000 ′ ″	50000 Eq. ☽. — ° ′ ″	Dif. ′ ″	D. Eq for D. 5000 ′ ″	55000 Eq. ☽. — ° ′ ″	Dif. ′ ″	D. Eq for D. 5000 ′ ″	60000 Eq. ☽. — ° ′ ″	Dif. ′ ″	D. Eq for D. 5000 ′ ″	65000 Eq. ☽. 65000 ° ′ ″	Dif. ′ ″	D. Eq for D. 5000 ′ ″	☽ eq A.	D of In fr. M for — ″
10	0	4 20 21	2 48	28 0	4 48 21	3 7	27 47	5 16 8	3 28	27 36	5 43 44	3 47	27 26	6 11 10	4 6	27 16	30	10
11	1	4 23 9	2 43	28 19	4 51 28	3 3	28 38	5 19 36	3 21	27 55	5 47 31	3 41	27 45	6 15 16	4 1	27 35	29	10
13	2	4 25 52	2 39	28 39	4 54 31	2 57	28 26	5 22 57	3 16	28 15	5 51 12	3 36	28 5	6 19 17	3 55	27 55	28	10
12	3	4 28 31	2 35	28 57	4 57 28	2 53	28 45	5 26 13	3 12	28 35	5 54 48	3 30	28 24	6 23 12	3 48	28 13	27	11
11	4	4 31 6	2 30	29 15	5 0 21	2 48	29 4	5 29 25	3 5	28 53	5 58 18	3 24	28 42	6 27 0	3 43	28 31	26	11
12	5	4 33 36	2 24	29 33	5 3 9	2 42	29 21	5 32 30	3 0	29 12	6 1 42	3 18	29 1	6 30 43	3 36	28 50	25	11
11	6	4 36 1	2 20	29 50	5 5 51	2 38	29 39	5 35 30	2 55	29 30	6 5 0	3 12	29 19	6 34 19	3 29	29 8	24	11
12	7	4 38 21	2 16	30 8	5 8 29	2 32	29 56	5 38 25	2 49	29 47	6 8 12	3 16	29 36	6 37 48	3 23	29 25	23	11
11	8	4 40 37	2 11	30 24	5 11 1	2 27	30 13	5 41 14	2 43	30 3	6 11 17	3 0	29 54	6 41 11	3 16	29 45	22	9
11	9	4 42 48	2 7	30 40	5 13 28	2 22	30 29	5 43 57	2 38	30 20	6 14 17	2 53	30 10	6 44 27	3 10	30 0	21	10
10	10	4 44 55	2 1	30 55	5 15 50	2 16	30 45	5 46 35	2 31	30 35	6 17 10	2 48	30 27	6 47 37	3 3	30 19	20	8
10	11	4 46 56	1 56	31 10	5 18 6	2 11	31 0	5 49 0	2 26	30 52	6 19 58	2 40	30 42	6 50 40	2 56	30 32	19	10
10	12	4 48 52	1 52	31 25	5 20 17	2 5	31 15	5 51 32	2 20	31 6	6 22 38	2 35	30 58	6 53 36	2 49	30 50	18	8
8	13	4 50 44	1 46	31 38	5 22 22	2 0	31 30	5 53 52	2 13	31 21	6 25 13	2 28	31 12	6 56 25	2 32	31 3	17	9
9	14	4 52 30	1 42	31 52	5 24 22	1 55	31 43	5 56 5	2 8	31 36	6 27 41	2 21	31 26	6 59 7	2 35	31 16	16	10
9	15	4 54 12	1 36	32 5	5 26 17	1 49	31 50	5 58 13	2 2	31 49	6 30 2	2 14	31 40	7 1 42	2 28	31 31	15	9
9	16	4 55 48	1 31	32 18	5 28 6	1 43	32 9	6 0 15	1 55	32 1	6 32 16	2 8	31 54	7 4 10	2 21	31 47	14	7
9	17	4 57 19	1 26	32 30	5 29 49	1 37	32 21	6 2 10	1 49	32 14	6 34 24	2 1	32 7	7 6 31	2 14	32 0	13	7
8	18	4 58 45	1 21	32 41	5 31 26	1 31	32 33	6 3 59	1 43	32 26	6 36 25	1 55	32 20	7 8 45	2 6	32 14	12	6
6	19	5 0 6	1 15	32 51	5 32 57	1 26	32 45	6 5 42	1 36	32 38	6 38 20	1 47	32 31	7 10 51	1 59	32 24	11	7
7	20	5 1 21	1 10	33 2	5 34 23	1 20	32 55	6 7 18	1 30	32 49	6 40 7	1 41	32 43	7 12 50	1 51	32 36	10	6
7	21	5 2 31	1 5	33 12	5 35 43	1 14	33 5	6 8 48	1 24	33 0	6 41 48	1 33	32 53	7 14 41	1 45	32 46	9	7
6	22	5 3 36	1 0	33 21	5 36 57	1 9	33 15	6 10 12	1 17	33 9	6 43 21	1 27	33 5	7 16 26	1 36	33 1	8	4
7	23	5 4 36	0 54	33 30	5 38 6	1 2	33 23	6 11 29	1 11	33 19	6 44 48	1 19	33 14	7 18 2	1 28	33 9	7	5
6	24	5 5 30	0 48	33 38	5 39 8	0 56	33 32	6 12 40	1 4	33 27	6 46 7	1 13	33 23	7 19 30	1 21	33 19	6	4
6	25	5 6 18	0 43	33 46	5 40 4	0 49	33 40	6 13 44	0 57	33 36	6 47 20	1 5	33 31	7 20 51	1 13	33 26	5	5
4	26	5 7 1	0 38	33 52	5 40 53	0 44	33 48	6 14 41	0 51	33 44	6 48 25	0 58	33 39	7 22 4	1 6	33 34	4	5
3	27	5 7 39	0 32	33 58	5 41 37	0 38	33 55	6 15 32	0 44	33 51	6 49 23	0 51	33 47	7 23 10	0 58	33 43	3	4
3	28	5 8 11	0 26	34 4	5 42 15	0 32	34 1	6 16 16	0 37	33 58	6 50 14	0 42	33 54	7 24 8	0 49	33 50	2	4
4	29	5 8 37	0 21	34 10	5 42 47	0 25	34 6	6 16 53	0 30	34 3	6 50 56	0 37	34 1	7 24 57	0 42	33 59	1	2
3	30	5 8 58		34 14	5 43 12		34 11	6 17 23		34 10	6 51 33		34 6	7 25 39		34 2	0	4
+ 5000 D	☽ eq A.	+ Eq. ☽. 45000	Dif.	5000 D. Eq	+ Eq. ☽. 55000	Dif.	5000 D. Eq	+ Eq. ☽. 55000	Dif.	5000 D. Eq	+ Eq. ☽. 60000	Dif.	5000 D. Eq	+ Eq. ☽. 65000	Dif.	5000 D. Eq	☽ eq A.	+ 5000 D.

SIGN 7.

EXAMPLE III. *To find the Equation of an Orbit correspondent to* 60000 *Eccentricity, and* 30°, *or* 1ˢ *Equated Mean Anomaly?* See p. 60. Laws of the Moon's Mean Motion, at the End of Vol. II. *Principia*.

By p. 84, under Eccentricity 60000 (the same as ,06 to 1 Rad.) and against 30° on the Side we find 3° 13′ 33″ required. Mr. *Machin* has deduced it by his Method 3° 13′ 34″. By *Bullialdus*'s Correction of *Ward*'s Hypothesis.

		Com. Logarithms.
As Sem. Conj.	$\sqrt{1,06 \times ,94}$	0.0007831 co.
To Sem. Transverse	,1	0.0000000
So T. M. Anom.	30°	9.7614394
To T. of corrected M. An.	30 2′ 41″	9.7622225

Correction of M. Anom. +2′ 41″ Difference.
Correction ½ M. Anom. +1 20½ the half, or Eqⁿ
M. Anom. corrected 15° 1′ 20″½

		Com. Logarithms.
Now, As Ap. Dist.	1.06	9.9746941 co.
To Perih. Dist.	,94	9.9731279
So T. 15° 1′ 20″½ } ½ M. Anom. corrected.		9.4287300
To T. ½ true An. 13° 23′ 12″		9.3765520
Double	26 46 24	
Equᵈ M. An.	30 0 0	
Equation	—3 13 36 the Difference.	

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES.

IV. ELLIPTIC EQUATION of the MOON's *Center*, according to the *Newtonian* Theory.

Argument. The Moon's Equated Anomaly, Or ☽ 3 Equated — ☽ Ap. 2 Equated.

SIGN. 3.

In. of Defr. M for − +	☽ eq. An	Eq. ☽. 45000 −	Dif.	D.Eq. for D. 5000	Eq. ☽. 50000 −	Dif.	D.Eq. for D. 5000	Eq. ☽. 55000 −	Dif.	D.Eq. for D. 5000	Eq. ☽. 60000 −	Dif.	D.Eq. for D. 5000	Eq. ☽. 65000 −	Dif.	D.Eq. for D. 5000	☽ eq. An	De & In. of In. fr. M. for −
″	°	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	°	″
3	0	5 8 58	0 16	34 14	5 43 12	0 20	34 11	6 17 23	0 24	34 10	6 51 33	0 28	34 6	7 25 39	0 34	34 2	30	4
3	1	5 9 14	0 10	34 18	5 43 32	0 13	34 15	6 17 47	0 17	34 14	6 52 1	0 21	34 12	7 26 13	0 25	34 10	29	2
2	2	5 9 24	0 4	34 21	5 43 45	0 7	34 19	6 18 4	0 10	34 18	6 52 22	0 13	34 16	7 26 38	0 18	34 14	28	2
2	3	5 9 28	0 2	34 24	5 43 52	0 0	34 22	6 18 14	0 3	34 21	6 52 35	0 7	34 21	7 26 56	0 10	34 21	27	0
1	4	5 9 26	0 7	34 26	5 43 52	0 6	34 25	6 18 17	0 4	34 25	6 52 42	0 2	34 24	7 27 6	0 1	34 23	26	1
0	5	5 9 19	0 13	34 27	5 43 46	0 12	34 27	6 18 13	0 11	34 27	6 52 40	0 9	34 27	7 27 7	0 7	34 27	25	0
0	6	5 9 6	0 19	34 28	5 43 34	0 18	34 28	6 18 2	0 18	34 29	6 52 31	0 17	34 29	7 27 0	0 15	34 29	24	+
—	7	5 8 47	0 24	34 29	5 43 16	0 25	34 28	6 17 44	0 24	34 30	6 52 14	0 24	34 31	7 26 45	0 23	34 32	23	1
1	8	5 8 23	0 30	34 28	5 42 51	0 31	34 29	6 17 20	0 32	34 30	6 51 50	0 32	34 32	7 26 22	0 32	34 34	22	2
1	9	5 7 53	0 36	34 27	5 42 20	0 37	34 28	6 16 48	0 39	34 30	6 51 18	0 39	34 32	7 25 50	0 39	34 34	21	2
0	10	5 7 17	0 41	34 26	5 41 43	0 44	34 26	6 16 9	0 45	34 30	6 50 39	0 47	34 32	7 25 11	0 49	34 34	20	2
2	11	5 6 36	0 48	34 23	5 40 59	0 51	34 25	6 15 24	0 53	34 28	6 49 52	0 56	34 30	7 24 22	0 57	34 32	19	2
3	12	5 5 48	0 53	34 20	5 40 8	0 56	34 23	6 14 31	1 0	34 25	6 48 56	1 3	34 29	7 23 25	1 5	34 33	18	4
2	13	5 4 55	0 58	34 17	5 39 12	1 3	34 19	6 13 31	1 7	34 22	6 47 53	1 10	34 27	7 22 20	1 13	34 32	17	5
3	14	5 3 57	1 5	34 12	5 38 9	1 10	34 15	6 12 24	1 14	34 19	6 46 43	1 18	34 24	7 21 7	1 22	34 29	16	5
4	15	5 2 52	1 10	34 7	5 36 59	1 16	34 11	6 11 10	1 21	34 15	6 45 25	1 26	34 19	7 19 45	1 30	34 23	15	4
5	16	5 1 42	1 16	34 1	5 35 43	1 22	34 6	6 9 49	1 29	34 10	6 43 59	1 33	34 16	7 18 15	1 39	34 22	14	6
4	17	5 0 26	1 22	33 55	5 34 21	1 29	33 59	6 8 20	1 35	34 6	9 42 26	1 42	34 10	7 16 36	1 47	34 14	13	4
5	18	4 59 4	1 27	33 48	5 32 52	1 35	33 53	6 6 45	1 42	33 59	6 40 44	1 49	34 5	7 14 49	1 55	34 11	12	6
6	19	4 57 37	1 33	33 40	5 31 17	1 41	33 46	6 5 3	1 49	33 52	6 38 55	1 57	33 59	7 12 54	2 4	34 6	11	7
6	20	4 56 4	1 39	33 32	5 29 36	1 48	33 38	6 3 14	1 57	33 44	6 36 58	2 4	33 52	7 10 50	2 13	34 0	10	8
6	21	4 54 25	1 44	33 23	5 27 48	1 54	33 29	6 1 7	2 3	33 37	6 34 54	2 12	33 43	7 8 37	2 20	33 49	9	6
7	22	4 52 41	1 50	33 13	5 25 54	2 1	33 20	5 59 14	2 11	33 28	6 32 42	2 21	33 35	7 6 17	2 30	33 42	8	7
8	23	4 50 51	1 56	33 2	5 23 53	2 6	33 10	5 57 3	2 17	33 18	6 30 21	2 27	33 26	7 3 47	2 37	33 34	7	8
7	24	4 48 55	2 1	32 52	5 21 47	2 13	32 59	5 54 46	2 25	33 8	6 27 54	2 36	33 16	7 1 10	2 46	33 24	6	8
7	25	4 46 54	2 7	32 40	5 19 34	2 20	32 47	5 52 21	2 31	32 57	6 25 18	2 43	33 6	6 58 24	2 54	33 15	5	9
9	26	4 44 47	2 13	32 27	5 17 14	2 25	32 36	5 49 50	2 38	32 45	6 22 35	2 51	32 55	6 55 30	3 3	33 5	4	10
8	27	4 42 34	2 18	32 15	5 14 49	2 32	32 23	5 47 12	2 45	32 32	6 19 44	2 58	32 43	6 52 27	3 11	32 54	3	11
9	28	4 40 16	2 23	32 1	5 12 17	2 38	32 10	5 44 27	2 53	32 19	6 16 46	3 6	32 30	6 49 16	3 19	32 41	2	11
9	29	4 37 53	2 29	31 46	5 9 39	2 44	31 55	5 41 34	2 59	32 6	6 13 40	3 13	32 17	6 45 57	3 28	32 28	1	11
9	30	4 35 24		31 31	5 6 55		31 40	5 38 35		31 52	6 10 27		32 2	6 42 29		32 12	0	10
+ 5000 D.	☽ eq. An	+ Eq. ☽. 45000	Dif.	5000 D.Eq.	+ Eq. ☽. 50000	Dif.	5000 D.Eq.	+ Eq. ☽. 55000	Dif.	5000 D.Eq.	+ Eq. ☽ 60000	Dif.	5000 D.Eq.	+ Eq. ☽. 65000	Dif.	5000 D.Eq.	☽ eq. An	+ 5000 D.

SIGN 8.

THE foregoing Example wrought out according to Dr. *Halley*'s Method.

Conft. Log.

Eccentricity ,06 to Rad. 1. . or 60000 to Rad. 1000000 gives 9.947824 . . 1s 5° 14′ Sun à ☽ Ap.

½ Equated M. Anom. 15°

P. 82 . . Correction 0 1′ 22″

15 1 22 Tang. ½ M. An. corrected . . 9.4287374 Log. +

Tang. ½ True Anom. 13° 23′ 12″ 44‴ 9.3765614

Doubled . 26 46 25 28 True An.

Equated M. Anom. 30

By Dr. *Halley* the Correct Equation — 3° 13′ 34″ 32‴ required.

By *Bullialdus* . — 3 13 36 0

\+ 1″ 28‴ Error.

SUPPLEMENTAL LUNAR TABLES.

IV. ELLIPTIC EQUATION of the MOON's *Center*, According to the Newtonian Theory.

Argument. The MOON's Equated Anomaly, Or ☽ 3. Equa^d. — ☽ Ap. 2. Equa^d.

SIGN 4.

D. of defr. M for	☽ Eq A.	45000 Æq. ☽.	Dif.	D. Eq for D. 5000	50000 Eq. ☽.	Dif.	D. Eq for D. 5000	55000 Eq. ☽.	Dif.	D. Eq for D. 5000	60000 Eq. ☽.	Dif.	D. Eq for D. 5000	65000 Eq. ☽.	Dif.	D. Eq for D. 5000	☽ Eq A.	In of Infr. M for ♄
—		—			—			—			—			—				—
°	°	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	°	°
9	0	4 35 24		31 31	5 6 55		31 40	5 38 35		31 52	6 10 27		32 2	6 42 29		32 12	30	10
9	1	4 32 49	2 35	31 16	5 4 5	2 50	31 25	5 35 30	3 5	31 36	6 7 6	3 21	31 48	6 38 54	3 35	32 0	29	12
10	2	4 30 9	2 40	30 59	5 1 8	2 57	31 9	5 32 17	3 13	31 21	6 3 38	3 28	31 32	6 35 10	3 44	31 43	28	11
10	3	4 27 24	2 45	30 42	4 58 6	3 2	30 52	5 28 58	3 19	31 4	6 0 2	3 36	31 16	6 31 18	3 52	31 28	27	12
10	4	4 24 34	2 50	30 24	4 54 58	3 8	30 34	5 25 32	3 26	30 47	5 56 19	3 43	30 59	6 27 18	4 0	31 11	26	12
12	5	4 21 38	2 56	30 5	4 51 43	3 15	30 17	5 22 0	3 32	30 29	5 52 29	3 50	30 41	6 23 10	4 8	30 53	25	12
12	6	4 18 37	3 1	29 46	4 48 23	3 20	29 58	5 18 21	3 39	30 10	5 48 31	3 58	30 23	6 18 54	4 16	30 36	24	13
11	7	4 15 30	3 7	29 27	4 44 57	3 26	29 38	5 14 35	3 46	29 51	5 44 26	4 5	30 4	6 14 30	4 24	30 17	23	13
12	8	4 12 19	3 11	29 6	4 41 25	3 32	29 18	5 10 43	3 52	29 31	5 40 14	4 12	29 44	6 9 58	4 32	29 51	22	13
14	9	4 9 3	3 16	28 44	4 37 47	3 38	28 58	5 6 45	3 58	29 10	5 35 55	4 19	29 24	6 5 19	4 39	29 38	21	14
13	10	4 5 41	3 22	28 23	4 34 4	3 43	28 36	5 2 40	4 5	28 49	5 31 29	4 26	29 3	6 0 32	4 47	29 17	20	14
13	11	4 2 14	3 27	28 1	4 30 15	3 47	28 14	4 58 29	4 11	28 27	5 26 56	4 33	28 41	5 55 37	4 55	28 55	19	14
12	12	3 58 42	3 32	27 39	4 26 21	3 54	27 51	4 54 12	4 17	28 4	5 22 16	4 40	28 18	5 50 34	5 3	28 32	18	14
11	13	3 55 6	3 36	27 15	4 22 21	4 0	27 27	4 49 48	4 24	27 41	5 17 29	4 47	27 55	5 45 24	5 10	28 9	17	14
12	14	3 51 25	3 41	26 51	4 18 16	4 5	27 3	4 45 19	4 29	27 17	5 12 36	4 53	27 31	5 40 7	5 17	27 45	16	14
13	15	3 47 40	3 45	26 25	4 14 5	4 11	26 38	4 40 43	4 36	26 53	5 7 36	5 0	27 6	5 34 42	5 25	27 19	15	13
13	16	3 43 49	3 51	26 0	4 9 49	4 16	26 13	4 36 2	4 41	26 27	5 2 29	5 7	26 42	5 29 11	5 31	26 57	14	15
13	17	3 39 54	3 55	25 34	4 5 28	4 21	25 47	4 31 15	4 47	26 1	4 57 16	5 13	26 16	5 23 32	5 39	26 31	13	15
14	18	3 35 54	4 0	25 7	4 1 1	4 27	25 21	4 26 22	4 53	25 35	4 51 57	5 19	25 49	5 17 46	5 46	26 3	12	14
14	19	3 31 50	4 4	24 40	3 56 30	4 31	24 54	4 21 24	4 58	25 7	4 46 31	5 26	25 22	5 11 53	5 53	25 37	11	15
13	20	3 27 42	4 8	24 12	3 51 54	4 36	24 25	4 16 19	5 5	24 40	4 40 59	5 32	24 54	5 5 53	6 0	25 10	10	14
15	21	3 23 29	4 13	23 43	3 47 12	4 42	23 58	4 11 10	5 9	24 11	4 35 21	5 38	24 26	4 59 47	6 6	24 41	9	15
15	22	3 19 12	4 17	23 14	3 42 26	4 46	23 29	4 5 55	5 15	23 42	4 29 37	5 44	23 57	4 53 34	6 13	24 12	8	15
13	23	3 14 50	4 22	22 46	3 37 36	4 50	22 59	4 0 35	5 20	23 12	4 23 47	5 50	23 27	4 47 14	6 20	23 42	7	15
15	24	3 10 25	4 25	22 15	3 32 40	4 56	22 30	3 55 10	5 25	22 42	4 17 52	5 55	22 56	4 40 48	6 26	23 10	6	14
13	25	3 5 56	4 29	21 45	3 27 41	4 59	21 58	3 49 39	5 31	22 12	4 11 51	6 1	22 25	4 34 16	6 31	22 38	5	13
13	26	3 1 22	4 34	21 14	3 22 36	5 5	21 27	3 44 3	5 36	21 41	4 5 44	6 7	21 54	4 27 38	6 38	22 7	4	13
12	27	2 56 45	4 37	20 43	3 17 28	5 8	20 55	3 38 23	5 40	21 9	3 59 32	6 12	21 22	4 20 54	6 44	21 35	3	13
13	28	2 52 5	4 40	20 10	3 12 15	5 13	20 23	3 32 38	5 45	20 36	3 53 14	6 18	20 50	4 14 4	6 50	21 14	2	14
12	29	2 47 20	4 45	19 38	3 6 58	5 17	19 50	3 26 48	5 50	20 4	3 46 52	6 22	20 16	4 7 8	6 56	20 28	1	12
12	30	2 42 32	4 48	19 5	3 1 37	5 21	19 17	3 20 54	5 54	19 30	3 40 24	6 28	19 43	4 0 7	7 1	19 56	0	13
		+			+			+			+			+				
5000 D.	☽ Eq A.	Eq. ☽. 45000	Dif.	5000 D. Eq	Eq. ☽. 50000	Dif.	5000 D. Eq	Eq. ☽. 55000	Dif.	5000 D. Eq	Eq. ☽. 60000	Dif.	5000 D. Eq	Eq. ☽. 65000	Dif.	5000 D. Eq	☽ Eq A.	5000 D.

SIGN 7.

To determine the EQUATION *of the Mean to the True Anomaly, or Mean to the true Place in all the* Planetary *Orbits except that of Mercury, for which the following* Rule *comes near the Truth.*

RULE (*deduced from expressions 1st and 2d p.* 49, *Palladium,* 1757.)

Art. 1. As Radius is to Cosine of the given Mean Anomaly, so is the *Eccentricity* of the Orbit more its *Fourth,* (Rad. or mean Dist. being 1.) to a *Fourth* Proportional.

2. Add this *Fourth Poroportional* to the Sem. *Transverse* (= 1.) if the Mean Anomaly given be *less* 90°, or *more* than 270°; or *Subtract* it from the Sem. Transverse if the Mean Anom. be *more* than 90 or less than 270°.

3. Then say, As the *Sum,* in one Case, or *Difference* in the other, is to double the said Eccentricity, so is the *Sine* of the given Mean Anomaly to the *Proportional Sine* of an Arc P.

4. The *Minutes* or *Seconds* of another Arc, answerable to *one third of the Cube* of this proportional *Sine* of an Arc P, being deducted from the Degrees Minutes and Seconds of the said Proportional Arc, P, the Result will be the *Equation* or *Difference* of Anomaly Sought.

N. B. *This Arc of Difference to be subtracted from the Mean Anomaly for the true in the first Six Signs of the Argument, and to be added thereto in the last Six Signs.*

SUPPLEMENTAL LUNAR TABLES.

IV. ELLIPTIC EQUATION of the MOON's *Center*. According to the *Newtonian* Theory.

ARGUMENT. The MOON's Equated Anomaly, or ☽ 3. Equa. — ☽ Ap. 2. Equated.

SIGN 5.

D. of D. fr. for	☽ eq A.	Eq. ☽. 45000	Dif.	D. Eq for D. 5000	Eq. ☽. 50000	Dif.	D. Eq for D. 5000	Eq. ☽. 55000	Dif.	D. Eq for D. 5000	Eq. ☽. 60000	Dif.	D.Eq. for D. 5000	Eq. ☽. 65000	Dif.	D.Eq. for D. 5000	☽ eq A.	D. of D. fr. for
—		—			—			—			—			—				+
″	°	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	° ′ ″	′ ″	′ ″	°	″
12	0	2 42 32	4 51	19 5	3 1 37	5 25	19 17	3 20 54	5 58	19 30	3 40 24	6 32	19 43	4 0 7	7 6	19 56	30	13
13	1	2 37 41	4 54	18 31	2 56 12	5 28	18 44	3 14 56	6 3	18 56	3 33 52	6 38	19 9	3 53 1	7 12	19 22	29	13
12	2	2 32 47	4 58	17 57	2 50 44	5 33	18 9	3 8 53	6 7	18 21	3 27 14	6 41	18 35	3 45 49	7 17	18 49	28	14
13	3	2 27 49	5 1	17 22	2 45 11	5 35	17 35	3 2 46	6 12	17 47	3 20 33	6 47	17 59	3 38 32	7 22	18 11	27	12
10	4	2 22 48	5 4	16 48	2 39 36	5 40	16 58	2 56 34	6 15	17 12	3 13 46	6 50	17 24	3 31 10	7 27	17 36	26	12
11	5	2 17 44	5 7	16 12	2 33 56	5 42	16 23	2 50 19	6 18	16 37	3 6 56	6 55	16 47	3 23 43	7 31	16 57	25	10
10	6	2 12 37	5 10	15 37	2 28 14	5 46	15 47	2 44 1	6 22	16 0	3 0 1	6 59	16 11	3 16 12	7 36	16 22	24	11
10	7	2 7 27	5 13	15 1	2 22 28	5 49	15 11	2 37 39	6 25	15 23	2 53 2	7 3	15 34	3 8 36	7 41	15 45	23	11
10	8	2 2 14	5 15	14 25	2 16 39	5 52	14 35	2 31 14	6 29	14 45	2 45 59	7 7	14 56	3 0 55	7 44	15 7	22	11
10	9	1 56 59	5 18	13 48	2 10 47	5 55	13 58	2 24 45	6 33	14 7	2 38 52	7 10	14 49	2 53 11	7 48	14 31	21	11
9	10	1 51 41	5 20	13 11	2 4 52	5 57	13 20	2 18 12	5 35	13 30	2 31 42	7 13	13 41	2 45 23	7 51	13 52	20	11
9	11	1 46 21	5 22	12 34	1 58 55	6 0	12 42	2 11 37	6 38	12 52	2 24 29	7 17	13 2	2 37 31	7 56	13 12	19	10
8	12	1 40 59	5 24	11 56	1 52 55	6 3	12 4	2 4 59	6 41	12 13	2 17 12	7 20	12 23	2 29 35	8 0	12 34	18	11
9	13	1 35 35	5 27	11 17	1 46 52	6 5	11 26	1 58 18	6 44	11 34	2 9 52	7 23	11 43	2 21 35	8 2	11 52	17	9
8	14	1 30 8	5 29	10 39	1 40 47	6 7	10 47	1 51 34	6 46	10 55	2 2 29	7 25	11 4	2 13 33	8 6	11 13	16	9
7	15	1 24 39	5 30	10 1	1 34 40	6 9	10 8	1 44 48	6 49	10 10	1 55 4	7 29	10 23	2 5 27	8 8	10 30	15	7
6	16	1 19 9	5 32	9 22	1 28 31	6 11	9 28	1 37 59	6 50	9 36	1 47 35	7 31	9 44	1 57 19	8 11	9 52	14	8
6	17	1 13 37	5 34	8 43	1 22 20	6 13	8 49	1 31 9	6 53	8 55	1 40 4	7 33	9 4	1 49 8	8 14	9 13	13	9
5	18	1 8 3	5 35	8 4	1 16 7	6 15	8 9	1 24 16	6 55	8 15	1 32 31	7 35	8 23	1 40 54	8 16	8 31	12	8
5	19	1 2 28	5 36	7 24	1 9 52	6 16	7 29	1 17 21	6 56	7 35	1 24 56	7 37	7 42	1 32 38	8 19	7 49	11	7
5	20	0 56 52	5 38	6 44	1 3 36	6 18	6 49	1 10 25	6 58	6 54	1 17 19	7 39	7 0	1 24 19	8 20	7 6	10	6
5	21	0 51 14	5 39	6 4	0 57 18	6 19	6 9	1 3 27	7 0	6 13	1 9 40	7 40	6 19	1 15 59	8 22	6 25	9	6
4	22	0 45 35	5 40	5 24	0 50 59	6 20	5 28	0 56 27	7 0	5 33	1 2 0	7 42	5 37	1 7 37	8 24	5 41	8	4
4	23	0 39 55	5 40	4 44	0 44 39	6 21	4 48	0 49 27	7 2	4 51	0 54 18	7 42	4 55	0 59 13	8 25	4 59	7	4
4	24	0 34 15	5 41	4 3	0 38 18	6 21	4 7	0 42 25	7 3	4 11	0 46 36	7 45	4 12	0 50 48	8 26	4 13	6	1
2	25	0 28 34	5 42	3 23	0 31 57	6 23	3 25	0 35 22	7 3	3 29	0 38 51	7 45	3 31	0 42 22	8 27	3 33	5	2
2	26	0 22 52	5 43	2 42	0 25 34	6 23	2 45	0 28 19	7 4	2 47	0 31 6	7 46	2 49	0 33 55	8 28	2 51	4	2
2	27	0 17 9	5 43	2 2	0 19 11	6 23	2 4	0 21 15	7 5	2 5	0 23 20	7 46	2 7	0 25 27	8 29	2 9	3	2
0	28	0 11 26	5 43	1 22	0 12 48	6 24	1 22	0 14 10	7 5	1 24	0 15 34	7 47	1 24	0 16 58	8 29	1 24	2	0
0	29	0 5 43	5 43	0 41	0 6 24	6 24	0 41	0 7 5	7 5	0 42	0 7 47	7 47	0 42	0 8 29	8 29	0 42	1	0
0	30	0 0 0		0 0	0 0 0		0 0	0 0 0		0 0	0 0 0		0 0	0 0 0		0 0	0	0
—		+			+			+			+			+				+
5000 D.	☽ eq A.	Eq. ☽. 45000	Dif.	5000 D. Eq	Eq. ☽. 50000	Dif.	5000 D. Eq	Eq. ☽. 55000	Dif.	5000 D.Eq.	Eq. ☽. 60000	Dif.	5000 D.Eq.	Eq. ☽. 65000	Dif.	5000 D.Eq.	☽ eq A.	(5000)

SIGN 6.

Let the equated mean Anomaly of the Moon be 72°. 12′ 36″ *and present Eccentricity of Her Orbit*, ,05 (*to 1 Radius, or Sem. Transverse*) *to find the Equation and also true Anomaly?*

Ex. of the foregoing RULE.

	Log.
As Rad.	10.0000000
To Cos. M. An. or Sine 17° 47′ 24″. . . .	9.4850526
So ,05 Eccy. + ¼ = ,0625.	8.7958800
To . . . . ,0190957	8.2809326
+ 1. *Sem. Trans.*	
As . . 1.0190957	9.9917850 co.
To . 0.1 Eccy. doubled	9.0000000
So S. M. An. 72° 12′ 36″	9.9787203
To S. 5° 21′ 40″	8.9705053
— 56	3
Eq. req. — 5 20 44 } 2′ . 48″	6.9115159 cubed.
M. An. 72 12 36 } Log. 3	0.4771215 *const.*—
True An. 66 51 52 } ⅓ . . — 56	6.4343944

required

By Dr. *Halley's* Correction of Bishop *Ward.*

½ M. An. 36° 6′ 18″ } Eccy. } 9.9565343 const. Log.
Correction + 45 } ,05 }
Cor. ½ M. A. 36 7 3 } Tan. 9.8631328
½ True An. 33 25 56 Tan. 9.8196671
doubd. tr. A. 66 51 52 as before.

By Bishop *Ward's* Hypothesis.

	Log.
Const. Log. for Orb.	9.9565343
½ M. Anomaly 36° 6′ 18″ T.	9.8620378
½ True Anom. 33 25 13 T.	9.8194681

Doubled is the True Anomaly 66 50 26 }
Equated M. Anom. 72 12 36 } required.
Whence the Equation 5 22 10 }

By *Bullialdus's* Correction of *Ward.*

As Sem. Conj. $\sqrt{1.05 \times ,95}$ . . . . . co.	0.0005435
To Sem. Trans. . . 1.	0.0000000
So T. M. Anom. . . . 72° 12′ 36″ . .	10.4936676
To T. corrected M. An. . . 72 13 51 . .	10.4942111
The Half . . . 36° 6′ 55″ . . . ,51	9.8630990
Constant Log. for Eccy. ,05 . . .	9.9565342
½ True Anom. 33° 25′ 49″	9.8196338

doubled the tr. A. 66 51 38 } — 14″ }
Equation 5 20 58 } + 14 } From Dr. *Halley.*
Error.

N. B. The ½ Dif. between M. and corrected M. An. is the Eq. or Correction of ½ M. or ½ equated An. *by Bullialdus.*

SUPPLEMENTAL LUNAR TABLES.

Or thus. EQUATION of the Mean to the present Elliptic Equation of the MOON's Center.

Arg. ⊙ à ☽'s Apogee, 1. equated.		SIGN 0. Argument. Equated Anomaly of the Moon; Or, ☽ 3. equated — Ap. ☽ 2. equated.															
		0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
s °	s °	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
0	6	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6 0	12 0	0	2 26	4 53	7 16	9 42	12 9	14 32	16 57	19 18	21 39	23 59	26 19	28 40	30 56	33 12	35 26
2	28	0	2 25	4 52	7 15	9 40	12 7	14 30	16 54	19 15	21 35	23 55	26 14	28 34	30 50	33 6	35 20
4	26	0	2 24	4 50	7 13	9 37	12 2	14 25	16 48	19 8	21 28	23 47	26 5	28 24	30 40	32 54	35 8
6	24	0	2 23	4 47	7 8	9 31	11 56	14 17	16 38	18 57	21 16	23 34	25 51	28 9	30 23	32 36	35 48
8	22	0	2 20	4 43	7 3	9 24	11 46	14 5	16 24	18 41	20 57	23 12	25 28	27 44	29 56	32 8	34 18
10	20	0	2 18	4 38	6 55	9 13	11 32	13 49	16 6	18 21	20 35	22 46	24 59	27 14	29 23	31 32	33 40
12	18	0	2 15	4 32	6 46	9 1	11 17	13 30	15 44	17 56	20 7	22 17	24 27	26 37	28 44	30 50	32 54
14	16	0	2 11	4 24	6 35	8 46	10 59	13 8	15 19	17 27	19 34	21 41	23 47	25 53	27 57	30 0	32 1
16	14	0	2 8	4 17	6 23	8 3	10 37	12 42	14 48	16 52	18 55	20 57	22 59	25 2	27 2	29 1	30 59
18	12	0	2 2	4 7	6 10	8 11	10 14	12 15	14 17	16 16	18 15	20 14	22 11	24 9	26 4	27 57	29 48
20	10	0	1 57	3 57	5 54	7 50	9 47	11 42	13 39	15 33	17 26	19 19	21 12	23 5	24 55	26 44	28 32
22	8	0	1 51	3 46	5 39	7 28	9 19	11 8	12 59	14 47	16 35	18 23	20 10	21 56	23 41	25 25	27 8
24	6	0	1 45	3 33	5 19	7 3	8 48	10 31	12 17	14 0	15 41	17 23	19 4	20 46	22 24	24 2	25 39
26	4	0	1 39	3 20	4 59	6 36	8 14	9 49	11 28	13 3	14 38	16 14	17 49	19 24	20 56	22 27	23 58
28	2	0	1 31	3 5	4 38	6 7	7 38	9 6	10 39	12 8	13 35	15 4	16 31	17 59	19 23	20 48	22 13
1 0	5 0	0	1 28	2 55	4 16	5 37	6 59	8 20	9 44	11 5	12 26	13 48	15 9	16 31	17 47	19 4	20 21
7 2	11 28	0	1 15	2 34	3 51	5 4	6 20	7 33	8 49	10 2	11 15	12 29	13 42	14 55	16 5	17 15	18 25
4	26	0	1 6	2 16	3 25	4 1	5 38	6 43	7 51	8 56	10 1	11 6	12 8	13 8	14 15	15 21	16 24
6	24	0	0 58	1 59	2 59	3 56	4 54	5 51	6 50	7 46	8 43	9 40	10 36	11 32	12 26	13 20	14 15
8	22	0	0 50	1 42	2 31	3 19	4 8	4 55	5 46	6 34	7 21	8 9	8 53	9 35	10 27	11 16	12 2
10	20	0	0 40	1 22	2 2	2 41	3 21	3 59	4 40	5 19	5 58	7 22	7 14	7 53	8 30	9 7	9 44
12	18	0	0 30	1 3	1 33	2 2	2 33	3 1	3 33	4 3	4 32	5 1	5 30	5 59	6 28	6 5[illegible]	7 24
14	16	0	0 20	0 43	1 3	1 22	1 44	2 3	2 24	2 44	3 4	3 23	3 42	4 1	4 21	4 41	5 1
16	14	0	0 10	0 23	0 33	0 42	0 53	1 2	1 15	1 25	1 35	1 44	1 54	2 4	2 16	2 26	2 34
18	12	0	0 0	0 0	0 1	0 1	0 2	0 1	0 4	0 4	0 3	0 3	0 3	0 4	0 3	0 5	0 5
			±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
20	10	0	0 10	0 18	0 29	0 40	0 49	1 0	1 9	1 19	1 30	1 39	1 48	1 57	2 6	2 15	2 25
22	8	0	0 20	0 38	1 1	1 22	1 40	2 1	2 20	2 41	3 1	3 20	3 40	3 59	4 17	4 36	4 56
24	6	0	0 30	0 59	1 32	2 3	2 33	3 4	3 33	4 4	4 33	5 3	5 33	6 1	6 29	6 58	7 27
26	4	0	0 41	1 20	2 2	2 43	3 23	4 5	4 45	5 26	6 5	6 44	7 24	8 2	8 40	9 17	9 55
28	2	0	0 51	1 40	2 33	3 24	4 14	5 5	5 56	6 46	7 34	8 23	9 13	10 1	10 49	11 36	12 24
2 0	4 0	0	1 1	2 0	3 3	4 4	5 4	6 5	7 6	8 6	9 4	10 3	11 1	11 59	12 56	13 52	14 48
8 2	10 28	0	1 11	2 20	3 33	4 44	5 52	7 3	8 13	9 23	10 31	11 39	12 47	13 53	15 0	16 6	17 10
4	26	0	1 21	2 40	4 2	5 22	6 40	8 0	9 19	10 38	11 55	13 12	14 29	15 45	17 1	18 16	19 28
6	24	0	1 30	2 59	4 30	5 59	7 26	8 55	10 22	11 50	13 17	14 43	16 9	17 33	18 57	20 20	21 42
8	22	0	1 38	3 16	4 58	6 34	8 9	9 47	11 26	13 3	14 36	16 9	17 43	19 16	20 48	22 19	23 48
10	20	0	1 47	3 33	5 23	7 7	8 50	10 36	12 20	14 5	15 49	17 31	19 13	20 53	22 33	24 12	25 48
12	18	0	1 55	3 49	5 47	7 38	9 29	11 22	13 13	15 6	16 58	18 47	20 36	22 24	24 11	25 57	27 41
14	16	0	1 2	4 4	6 9	8 6	10 4	12 5	14 0	16 0	18 1	19 57	21 53	23 47	25 41	27 34	29 27
16	14	0	2 9	4 17	6 28	8 32	10 36	12 44	14 47	16 52	18 58	21 1	23 2	25 2	27 3	29 1	30 57
18	12	0	2 14	4 28	6 47	8 56	11 4	13 17	15 26	17 38	19 49	21 57	24 4	26 9	28 15	30 18	32 19
20	10	0	2 19	4 38	7 2	9 15	11 28	13 46	16 0	18 16	20 33	22 46	24 57	27 7	29 17	31 24	33 30
22	8	0	2 23	4 40	7 14	9 31	11 48	14 11	16 28	18 48	21 8	23 25	25 40	27 54	30 8	32 19	34 29
24	6	0	2 26	4 53	7 24	9 44	12 5	14 30	16 51	19 14	21 38	23 58	26 16	28 33	30 50	33 5	35 17
26	4	0	2 28	4 57	7 31	9 54	12 17	14 44	17 7	19 32	21 58	24 20	26 41	28 59	31 19	33 36	35 50
28	2	0	2 30	4 59	7 34	9 57	12 22	14 52	17 10	19 43	22 10	24 33	26 55	29 15	31 36	33 54	36 9
3 0	3 0	0	2 31	5 2	7 37	10 1	12 2[illegible]	14 56	17 20	19 47	22 15	24 39	27 2	29 22	31 43	34 2	36 18
9	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
⊙ à ☽'s Ap. 1. equated.		30°	28°	26°	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°	2°	0°
		SIGN 11.															

N. B. *If any Number of Minutes should chance to be misprinted, it will appear by the foregoing and following Quantities, at Sight.*

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES.

EQUATION of the MEAN to the present ELLIPTIC EQUATION of the MOON's CENTER.

SIGN 1.

Argument. Equated ANOMALY of the MOON; Or, ☽ 3. equated — Ap. ☽ 2. equated.

Arg. ☉ à ☽'s Apogee, 1. equated. S °	S °	0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6	6	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6 0	12 0	35 26	37 38	39 50	41 58	44 6	46 9	48 11	50 11	52 9	54 4	55 56	57 44	59 31	61 12	62 50	64 25
2	28	35 20	37 31	39 42	41 48	43 57	46 1	48 2	50 2	52 0	53 54	55 45	57 32	59 19	61 0	62 38	64 12
4	26	35 8	37 18	39 29	41 36	43 43	45 46	47 46	49 45	51 43	54 36	55 27	57 13	59 0	60 40	62 17	63 51
6	24	35 48	36 57	39 7	41 14	43 19	45 20	47 19	49 17	51 13	53 5	54 56	56 41	58 26	60 5	61 36	63 15
8	22	34 18	36 25	38 33	40 37	42 41	44 38	46 37	48 34	50 28	52 18	54 7	55 52	57 35	59 13	60 48	62 20
10	20	33 40	35 44	37 50	39 53	41 45	43 51	45 46	47 41	49 33	51 21	53 8	54 51	56 34	58 7	59 39	61 10
12	18	32 54	34 57	37 0	38 50	40 58	42 52	44 45	46 36	48 26	50 12	51 57	53 37	55 18	56 50	58 21	59 49
14	16	32 1	33 59	35 59	37 55	39 51	41 42	43 31	45 20	47 6	48 49	50 29	52 8	53 46	55 16	56 44	58 10
16	14	30 59	32 54	34 48	36 42	38 34	40 22	42 7	43 52	45 36	47 16	48 54	50 29	52 2	53 30	54 56	56 20
18	12	29 48	31 39	33 31	35 19	37 7	38 51	40 33	42 13	43 52	45 29	47 3	48 34	50 4	51 30	52 52	54 10
20	10	28 32	30 19	32 6	33 48	35 32	37 11	38 48	40 24	41 59	43 31	45 2	46 28	47 54	49 16	50 35	51 51
22	8	27 8	28 48	30 30	32 9	33 48	35 22	36 53	38 25	39 56	41 23	42 50	44 12	45 33	46 51	48 5	49 17
24	6	25 39	27 14	28 50	30 23	31 58	33 27	34 53	36 20	37 45	39 7	40 30	41 48	43 4	44 17	45 28	46 37
26	4	23 58	25 27	26 57	28 24	29 52	31 14	32 33	33 54	35 15	36 32	37 49	39 2	40 14	41 22	42 28	43 32
28	2	22 13	23 35	24 59	26 19	27 42	28 59	30 12	32 27	32 41	33 52	35 4	36 11	37 16	38 20	39 22	40 21
1 0	5 0	20 21	21 37	22 54	24 7	25 24	26 34	27 40	28 49	29 57	31 2	32 8	33 9	34 10	35 8	36 4	36 59
7 2	11 28	18 25	19 33	20 43	21 49	22 56	23 59	25 2	26 3	27 4	28 3	29 0	29 56	30 53	31 45	32 37	33 27
4	26	16 24	17 24	18 26	19 26	20 25	21 21	22 18	23 12	24 6	24 58	25 49	26 38	27 30	28 16	29 1	29 45
6	24	14 15	15 7	16 1	16 53	17 44	18 33	19 23	20 10	20 57	21 42	22 26	23 8	23 53	24 33	25 12	25 50
8	22	12 2	12 46	13 31	14 15	14 59	15 41	16 22	17 1	17 40	18 18	18 56	19 32	20 10	20 43	21 15	21 47
10	20	9 44	10 19	10 56	11 32	12 8	12 41	13 15	13 46	13 18	14 49	15 20	15 48	16 18	16 46	17 12	17 36
12	18	7 24	7 49	8 18	8 46	9 13	9 38	10 5	10 27	10 51	11 15	11 38	12 0	12 23	12 43	13 2	13 19
14	16	5 1	5 17	5 37	5 55	6 14	6 31	6 49	7 3	7 19	7 35	7 51	8 5	8 21	8 35	9 47	8 58
16	14	2 34	2 42	2 52	3 2	3 13	3 21	3 31	3 37	3 45	3 43	3 51	4 8	4 17	4 22	4 26	4 30
18	12	0 5	0 4	0 5	0 5	0 7	0 5	0 5	0 6	0 7	0 6	0 5	0 5	0 7	0 5	0 6	0 9
		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
20	10	2 25	2 35	2 42	2 51	2 59	3 8	3 17	3 26	3 33	3 42	3 49	3 58	4 3	4 11	4 18	4 22
22	8	4 56	5 15	5 32	5 50	6 7	6 26	6 43	7 0	7 15	7 31	7 46	8 2	8 15	8 13	8 44	8 56
24	6	7 27	7 55	8 21	8 48	9 14	9 41	10 7	10 33	10 57	11 20	11 42	12 6	12 27	13 49	13 10	13 29
26	4	9 55	10 33	11 18	11 45	12 19	12 55	13 30	14 3	14 35	15 7	15 38	16 9	16 38	17 8	17 35	17 59
28	2	12 24	13 10	13 54	14 40	15 23	16 8	16 52	17 33	18 12	18 51	19 29	20 8	20 43	21 20	21 55	22 27
2 0	4 0	14 48	15 46	16 37	17 31	18 23	19 17	20 8	20 58	21 46	22 34	23 19	24 5	24 47	25 31	26 12	26 50
8 2	10 28	17 10	18 15	19 17	20 19	21 19	22 20	23 20	24 18	26 14	26 9	27 1	27 54	28 43	29 33	30 20	31 6
4	26	19 28	20 40	21 50	23 0	24 10	25 21	26 29	27 34	28 36	29 39	30 38	31 38	32 34	33 30	34 24	35 16
6	24	21 42	23 1	24 20	25 42	26 56	28 13	29 28	30 40	31 49	34 58	34 5	35 13	36 17	37 19	38 18	39 14
8	22	23 48	25 14	26 41	28 11	29 33	30 58	32 21	33 40	34 57	36 13	37 25	38 38	39 48	40 56	42 1	43 3
10	20	25 48	27 21	28 55	30 33	32 3	33 34	35 3	36 30	37 53	39 15	40 34	41 52	43 6	44 22	45 33	46 40
12	18	27 41	29 19	30 59	32 46	34 21	35 58	37 35	39 7	40 35	42 2	43 29	44 54	46 15	47 35	48 50	50 1
14	16	29 27	31 9	32 54	34 48	36 29	38 12	39 55	41 33	43 8	44 41	46 10	47 40	49 7	50 30	51 50	53 6
16	14	30 57	32 45	34 37	36 38	38 24	40 13	42 1	43 44	45 24	47 3	48 35	50 8	51 39	53 9	54 33	55 53
18	12	32 19	34 13	36 9	38 15	40 6	42 0	43 53	45 40	47 24	49 8	50 46	52 24	53 59	55 31	56 59	58 21
20	10	33 30	35 27	37 29	39 40	41 34	43 32	45 30	47 21	49 8	50 55	52 38	54 20	55 58	57 33	59 3	60 29
22	8	34 29	36 29	38 35	40 51	42 47	44 48	46 49	48 44	50 35	52 24	54 9	55 53	57 34	59 12	60 47	62 17
24	6	35 17	37 20	39 28	41 46	43 46	45 49	47 52	49 51	51 46	53 37	55 24	57 11	58 55	60 36	62 11	63 41
26	4	35 50	37 55	40 6	42 26	44 28	46 34	48 40	50 40	52 36	54 29	56 17	58 6	59 51	61 33	63 9	64 41
28	2	36 9	38 22	40 34	42 49	44 52	46 59	49 8	51 6	53 3	54 58	56 47	58 36	60 23	62 6	63 44	65 16
3 0	3 0	36 18	38 33	40 45	42 57	45 3	47 10	49 16	51 16	53 13	55 9	56 59	58 52	60 35	62 18	63 56	65 30
9	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
☉ à ☽'s Ap 1. equated.		30°	28°	26°	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°	2°	0°

SIGN 10.

*** *If any Error is suspected in any Place, add the foregoing and following Quantities together, and the Half of that Sum will ascertain the Truth in the middle Column, or Place suspected.*

SUPPLEMENTAL LUNAR TABLES.

EQUATION of the MEAN to the present ELLIPTIC EQUATION of the MOON's CENTER.

SIGN 2.

Arg. ⊙ à ☽'s Apogee, 1. equated.		*Argument.* Equated ANOMALY of the MOON; Or, ☽ 3. Equated—Ap. ☽ 2. equated.															
		0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
s °	s °	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	6																
6 0	12 0	64 25	66 0	67 30	68 56	70 15	71 31	72 43	73 51	74 55	75 56	76 48	77 36	78 21	79 1	79 34	80 3
2	28	64 12	65 46	67 16	68 43	70 2	71 18	72 29	73 37	74 41	75 42	76 34	77 21	78 6	78 46	79 19	79 47
4	26	63 51	65 25	66 54	68 18	69 38	70 54	72 6	73 12	74 16	75 17	76 8	76 55	77 39	78 19	78 52	79 20
6	24	63 15	64 48	66 15	67 39	68 58	70 13	71 24	72 30	73 34	74 35	75 25	76 12	76 56	77 35	78 7	78 35
8	22	62 20	63 51	55 17	66 41	67 58	69 12	70 21	71 27	72 29	73 25	74 15	75 5	75 47	76 26	76 58	77 26
10	20	61 10	62 39	64 5	65 29	66 46	67 55	69 3	70 7	71 8	72 7	72 56	73 42	74 25	75 2	75 33	76 0
12	18	59 49	61 16	62 40	64 0	65 14	65 15	67 31	68 33	69 33	70 30	71 17	72 1	72 42	73 21	73 52	74 18
14	16	58 10	59 35	60 56	62 15	63 26	64 35	65 40	66 40	67 38	68 33	69 20	70 3	70 43	71 19	71 49	72 14
16	14	56 20	57 40	58 57	60 1	61 24	62 28	63 30	64 28	65 24	66 19	67 4	67 46	68 25	68 58	69 27	69 53
18	12	54 10	55 29	56 45	57 56	59 3	60 6	61 5	62 4	62 59	63 50	64 33	65 13	65 50	66 24	66 52	67 16
20	10	51 51	53 6	54 17	55 27	56 31	57 33	58 34	59 26	60 16	61 5	61 46	62 24	62 59	63 31	63 58	64 20
22	8	49 17	50 29	51 37	52 43	53 46	54 42	55 37	56 29	57 18	58 4	58 34	59 19	59 52	60 23	60 48	61 10
24	6	46 37	47 44	48 48	49 51	50 48	51 43	52 34	53 24	54 11	54 54	55 31	56 4	56 35	57 4	57 28	57 48
26	4	43 32	44 35	45 34	46 32	47 26	48 17	49 5	49 51	50 35	51 15	51 49	52 20	52 48	53 16	53 39	53 57
28	2	40 21	41 19	42 14	43 8	43 58	44 45	45 29	46 13	46 52	47 29	48 1	48 30	48 56	49 22	49 42	49 59
1 0	5 0	36 59	37 52	38 42	39 31	40 17	41 0	41 39	42 19	42 56	43 30	43 59	44 26	44 49	45 13	45 31	45 47
7 2	11 28	33 27	34 14	34 59	35 43	36 24	37 4	37 41	38 15	38 48	39 20	39 47	40 11	40 32	40 52	41 9	41 23
4	26	29 45	30 28	31 8	31 46	32 24	33 0	33 32	34 2	34 31	35 0	35 24	35 45	36 4	36 24	36 38	36 50
6	24	25 50	26 27	27 2	27 36	28 9	28 39	29 8	29 34	29 59	30 24	30 45	31 3	31 19	31 36	31 49	31 59
8	22	21 47	22 20	22 50	23 18	23 45	24 11	24 35	24 58	25 19	25 40	25 57	26 12	26 25	26 39	26 50	26 58
10	20	17 36	18 4	18 29	18 52	19 14	19 35	19 54	20 12	20 30	20 48	21 1	21 12	21 23	21 35	21 43	21 49
12	18	13 19	13 42	14 2	14 19	14 35	14 51	15 6	15 20	15 34	15 48	15 57	16 5	16 13	16 23	16 30	16 36
14	16	8 58	9 15	9 29	9 40	9 51	10 2	10 12	10 22	10 32	10 40	10 46	10 52	10 57	11 3	11 8	11 14
16	14	4 30	4 43	4 51	4 56	5 3	5 8	5 13	5 18	5 23	5 29	5 31	5 33	5 35	5 39	5 43	5 47
18	12	0 9	0 3	0 9	0 8	0 9	0 9	0 9	0 9	0 9	0 10	0 9	0 9	0 8	0 10	0 18	0 11
		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
20	10	4 22	4 30	4 37	4 41	4 46	4 52	4 57	5 1	5 4	5 7	5 12	5 17	5 20	5 20	5 22	5 23
22	8	8 56	9 8	9 20	9 32	9 43	9 53	10 1	10 12	10 22	10 29	10 36	10 43	10 50	10 54	10 58	11 1
24	6	13 29	13 47	14 6	14 24	14 40	14 55	15 10	15 24	15 37	15 47	15 58	16 9	16 19	16 23	16 30	16 36
26	4	17 59	18 24	18 48	19 12	19 33	19 54	20 13	20 33	20 50	20 54	21 19	21 32	21 45	21 52	22 0	22 8
28	2	22 27	22 58	23 27	23 56	24 21	24 49	25 13	25 37	25 59	26 16	26 34	26 51	27 6	27 15	27 27	27 37
2 0	4 0	26 50	27 26	28 2	28 37	29 9	29 39	30 8	30 38	31 4	31 25	31 46	32 5	32 24	32 35	32 48	33 0
8 2	10 21	31 6	31 49	32 30	33 10	33 48	34 24	34 57	35 31	36 0	36 24	36 48	37 11	37 32	37 37	38 2	38 14
4	26	35 16	36 4	36 51	37 36	38 20	39 c	39 36	40 14	40 47	41 14	41 41	42 8	42 33	42 49	43 5	43 19
6	14	39 14	40 9	41 2	41 52	42 39	43 24	44 7	44 47	45 24	45 55	46 25	46 53	47 20	47 38	47 57	48 13
8	22	43 3	44 2	45 0	45 55	46 37	47 36	48 22	49 7	49 48	50 23	50 55	51 20	51 55	52 14	52 34	52 52
10	20	46 40	47 44	48 46	49 46	50 42	51 35	52 24	53 13	53 57	54 34	55 9	55 42	56 13	56 36	56 58	57 17
12	18	50 1	51 10	52 17	53 21	54 20	55 56	56 10	57 2	57 49	58 29	59 7	59 42	60 15	60 39	61 2	61 22
14	16	53 6	54 19	55 29	56 38	57 41	58 41	59 38	60 33	61 23	62 6	62 45	63 22	63 57	64 23	64 47	65 9
16	14	55 53	57 10	58 25	59 36	60 43	61 46	62 46	63 43	64 35	65 21	66 2	66 41	67 18	67 45	68 11	68 34
18	12	58 21	59 42	61 1	62 15	63 24	64 29	65 32	65 32	67 26	68 14	67 57	69 37	70 16	70 44	71 11	71 34
20	10	60 29	61 54	63 15	64 32	65 43	66 50	67 35	68 56	69 53	70 44	71 27	72 8	72 49	73 19	73 46	74 10
22	8	62 17	63 42	65 5	66 25	67 38	68 48	69 54	70 58	71 56	72 47	73 33	74 16	74 56	75 26	75 56	76 20
24	6	63 41	65 9	66 34	67 56	69 10	70 21	71 30	72 35	73 33	74 22	75 11	75 56	76 38	77 10	77 39	78 3
26	4	64 41	66 10	67 37	69 0	70 16	71 28	72 37	73 43	74 43	75 37	76 26	77 9	77 51	78 23	78 52	79 17
28	2	65 16	66 45	68 12	69 36	70 53	72 6	73 16	74 22	75 23	76 17	77 6	77 51	78 33	79 5	79 34	79 59
3 0	3 0	65 30	67 0	68 28	69 52	71 9	72 22	73 33	74 39	75 40	76 34	77 21	78 6	78 49	79 21	79 50	80 15
9	)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
⊙ à ☽'s Ap. 1. equated.		30°	28°	26°	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°	2°	0°

SIGN 9

SUPPLEMENTAL LUNAR TABLES.

EQUATION of the MEAN to the present ELLIPTIC EQUATION of the MOON's CENTER.

SIGN 3.

Argument. Equated ANOMALY of the MOON; Or, ☽ 3. equated — Ap. ☽ 2. equated.

Arg. ☉ à ☽'s Apogee, 1. equated.		0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
s °	s °	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	6																
6 0	12 0	80 3	80 23	80 41	80 53	80 57	80 56	80 48	80 36	80 14	79 52	79 17	78 38	77 53	77 0	76 2	75 0
2	28	79 47	80 8	80 26	80 38	80 43	80 42	80 33	80 20	79 58	79 38	79 2	78 23	77 38	76 45	75 48	74 46
4	26	79 20	79 41	79 58	80 10	80 15	80 13	80 4	79 52	79 30	79 10	78 35	77 56	77 12	76 18	75 22	74 21
6	24	78 35	78 55	79 13	79 25	79 29	79 27	79 18	79 7	78 46	78 26	77 50	77 11	76 27	75 34	74 38	73 38
8	22	77 26	77 45	78 2	78 14	78 19	78 17	78 8	77 57	77 37	77 17	76 42	76 4	75 21	74 28	73 33	72 33
10	20	76 0	76 19	76 36	76 46	76 50	76 49	76 40	76 29	76 9	75 51	75 15	74 37	73 55	73 3	72 9	71 11
12	18	74 18	74 37	74 53	75 2	75 6	75 5	74 56	74 46	74 26	74 7	73 34	72 57	72 15	71 24	70 31	69 34
14	16	72 14	72 32	72 47	72 57	73 2	73 0	72 51	72 41	72 22	72 2	71 30	70 55	70 14	69 25	68 34	67 39
16	14	69 53	70 13	70 28	70 34	70 38	70 38	70 31	70 19	70 0	69 44	69 13	68 38	67 58	67 11	66 22	65 28
18	12	67 16	67 33	67 46	68 54	67 58	67 57	67 49	67 39	67 21	67 5	66 35	66 1	65 22	64 37	63 49	62 57
20	10	64 20	64 36	64 49	64 57	65 1	64 59	64 52	64 43	64 25	64 8	63 39	63 8	62 31	61 47	61 1	60 11
22	8	61 10	61 24	61 36	61 44	61 47	62 46	61 40	61 31	61 14	60 58	60 29	59 59	59 24	58 42	57 59	57 12
24	6	57 48	58 2	58 14	58 20	58 22	58 21	58 6	58 4	57 51	57 36	57 9	56 40	56 7	55 28	54 47	54 3
26	4	53 57	54 10	54 18	54 18	54 26	54 28	54 23	54 17	54 1	53 45	53 20	52 53	52 21	51 45	51 7	50 26
28	2	49 59	50 10	50 17	50 17	50 23	50 25	50 23	50 17	50 1	49 47	49 24	48 59	48 27	47 54	47 20	46 42
1 0	5 0	45 47	45 57	46 3	46 2	46 10	46 12	46 7	46 1	45 47	45 25	45 14	44 51	44 23	43 53	43 20	42 44
7 2	11 28	41 23	41 32	41 41	41 45	41 47	41 46	41 41	41 35	41 22	41 11	40 51	40 30	40 6	39 38	39 9	38 38
4	26	36 50	36 57	37 4	37 7	37 9	37 9	37 5	37 0	36 48	36 40	36 21	36 3	35 41	35 16	34 50	34 21
6	24	31 39	32 6	32 12	32 15	32 16	32 16	32 13	32 9	31 47	31 49	31 33	31 17	31 57	30 35	30 12	29 44
8	22	26 58	27 4	27 10	27 12	27 14	27 14	27 11	27 7	26 57	26 51	26 35	26 22	26 6	25 48	25 30	25 10
10	20	21 49	21 54	21 59	22 1	22 2	22 2	22 0	21 58	21 49	21 43	21 32	21 21	21 7	20 53	20 38	20 21
12	18	16 36	16 39	16 41	16 41	16 42	16 43	16 41	16 40	16 33	16 30	16 21	16 12	16 1	15 49	15 39	14 26
14	16	11 14	11 16	11 18	11 16	11 17	11 17	11 16	11 16	11 10	11 8	11 1	10 56	10 49	10 41	10 34	10 24
16	14	5 47	5 46	5 49	5 55	5 49	5 45	5 44	5 46	5 42	5 42	5 38	5 36	5 32	5 28	5 24	5 18
18	12	0 11	0 10	0 10	0 10	0 10	0 10	0 9	0 11	0 8	0 10	0 9	0 9	0 8	0 8	0 9	0 9
		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
20	10	5 23	5 27	5 28	5 28	5 27	5 27	5 30	5 26	5 25	5 19	5 20	5 19	5 17	5 13	5 8	5 3
22	8	11 1	11 5	11 6	11 8	11 6	11 6	11 9	11 4	11 2	10 54	10 52	10 47	10 43	10 35	10 25	10 16
24	6	16 36	16 41	16 44	16 46	16 46	16 45	16 46	16 40	16 37	16 27	16 23	16 15	16 5	15 53	15 40	15 27
26	4	22 8	22 15	22 19	22 21	22 20	22 19	22 18	22 12	22 9	21 58	21 49	21 38	21 26	21 11	20 53	20 35
28	2	27 37	27 46	27 50	27 51	27 51	27 50	27 48	27 41	27 36	27 24	27 13	26 58	26 43	26 23	26 0	25 38
2 0	4 0	33 0	33 10	33 15	33 17	33 17	33 14	33 11	23 3	32 57	32 43	32 29	32 11	31 52	31 29	31 3	30 37
8 2	10 28	38 14	38 25	38 30	38 33	38 34	38 32	38 28	38 18	38 10	37 56	37 38	37 17	36 55	36 28	35 58	35 26
4	26	43 18	43 30	43 37	43 41	43 39	43 38	43 33	43 23	43 15	42 57	42 38	42 14	41 49	41 18	40 44	40 8
6	24	48 13	48 26	48 33	48 37	48 37	48 33	48 27	48 15	48 6	47 47	47 25	46 57	46 0	45 55	45 17	44 38
8	22	52 52	53 5	53 13	53 17	53 17	53 13	53 28	52 54	52 42	52 22	51 57	51 28	50 58	50 20	49 38	48 54
10	20	57 17	57 30	57 38	57 43	57 43	57 39	57 33	57 27	57 4	56 42	56 15	55 44	55 10	54 29	53 44	52 57
12	18	61 22	61 37	61 46	61 51	61 49	61 43	61 35	61 21	61 8	60 45	60 16	59 42	59 6	58 22	57 34	56 43
14	16	65 9	65 24	65 33	65 39	65 37	65 33	65 26	65 12	64 52	64 27	63 56	63 21	62 43	61 55	61 4	60 10
16	14	68 34	68 50	68 59	69 3	69 2	68 57	68 50	68 32	68 15	67 48	67 15	66 38	65 58	65 8	64 14	63 17
18	12	71 34	71 50	71 59	72 5	72 3	71 58	71 50	71 31	71 13	70 46	70 12	69 32	68 50	67 59	67 3	66 3
20	10	74 10	74 27	74 37	74 43	74 41	74 35	74 27	74 8	73 49	73 20	72 45	72 4	71 19	70 25	69 28	68 26
22	8	76 20	76 37	76 46	76 51	77 49	76 43	76 33	76 11	75 52	75 26	74 51	74 9	73 24	72 30	71 30	70 26
24	6	78 3	78 22	78 32	78 37	78 34	78 28	78 21	78 0	77 40	77 10	76 32	75 49	75 3	74 5	73 5	71 59
26	4	79 17	79 34	79 45	79 51	79 48	79 42	79 34	79 12	78 51	78 21	77 44	77 0	76 12	75 15	74 12	73 6
28	2	79 59	80 17	80 27	80 33	80 30	80 24	80 16	79 54	79 33	79 2	78 25	77 40	76 52	75 55	74 52	73 45
3 0	3 0	80 15	80 33	80 44	80 51	80 48	80 42	80 30	80 12	79 50	79 18	78 41	77 56	76 8	76 11	75 8	74 0
	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
☉ à ☽'s Ap 1. equated.		30°	28°	26°	24°	22°	20°	18°	16°	14°	20°	10°	8°	6°	4°	2°	0°

SIGN 8.

SUPPLEMENTAL LUNAR TABLES.

EQUATION of the MEAN to the present ELLIPTIC EQUATION of the MOON's CENTER.

SIGN 4.

Argument. Equated ANOMALY of the MOON; Or, ☽ 3. equated — Ap. ☽ 2. equated.

Arg. ☉ à ☽'s Apogee, 1. equated.		0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
s °	s °	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
0	6	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6 0	12 0	75 0	73 45	72 27	71 4	69 30	67 53	66 9	64 18	62 22	60 22	58 12	55 56	53 34	51 7	48 38	46 2
2	28	74 46	73 30	72 13	70 5	69 18	67 41	65 57	64 7	62 12	60 10	58 0	55 45	53 24	50 57	48 28	45 53
4	26	74 21	73 6	71 48	70 2	68 53	67 17	65 34	63 53	61 48	59 49	57 40	55 26	53 8	50 40	48 12	45 37
6	24	73 38	72 24	71 8	69 4	68 13	66 38	64 57	63 8	61 13	59 14	57 7	54 54	52 36	50 11	47 45	45 12
8	22	72 33	71 20	70 5	68 4	67 14	65 39	63 58	62 11	60 18	58 21	56 15	54 5	51 49	49 26	47 2	44 32
10	20	71 11	70 0	68 46	67 2	65 59	64 27	62 48	61 2	59 11	57 17	55 13	53 4	50 50	48 29	46 9	43 42
12	18	69 34	68 25	67 13	65 5	64 28	62 58	61 23	59 38	57 49	55 58	53 57	51 51	49 41	47 24	45 6	42 41
14	16	67 39	66 30	65 20	64 4	62 40	61 13	59 39	57 58	56 12	54 24	52 27	50 25	48 19	46 5	43 51	41 30
16	14	65 28	64 22	63 15	62 [illegible]	60 39	59 15	57 44	56 7	54 24	52 39	50 46	48 49	46 48	44 37	42 26	40 7
18	12	62 57	61 54	60 48	59 37	58 19	56 58	55 29	53 57	52 19	50 36	48 46	46 53	44 57	42 51	40 47	38 39
20	10	60 11	59 10	58 8	57 [illegible]	55 45	54 27	53 3	51 34	50 0	48 23	46 39	44 52	43 0	40 59	38 59	36 54
22	8	57 12	56 14	55 15	54 11	52 59	51 44	50 25	49 0	47 30	45 5[illegible]	44 19	42 37	40 52	38 57	37 2	35 3
24	6	54 3	53 8	52 12	51 11	50 3	48 53	47 38	46 17	44 52	43 24	41 52	40 16	38 37	36 47	34 59	33 7
26	4	50 26	49 35	48 42	47 45	46 41	45 36	44 25	43 10	41 51	40 29	39 4	37 35	36 2	34 19	32 59	30 54
28	2	46 42	45 54	45 6	44 14	43 14	42 14	41 9	40 1	38 45	37 28	36 0	34 47	33 23	31 46	30 13	28 36
1 0	5 0	42 44	42 0	41 17	40 28	39 38	38 43	37 40	36 35	35 28	34 18	33 5	31 51	31 35	29 5	27 39	26 10
7 2	11 28	38 38	37 58	37 18	36 33	35 45	34 55	34 1	33 3	32 2	30 59	29 53	28 43	27 28	26 13	24 58	23 38
4	26	34 21	33 46	33 11	32 32	31 48	31 3	30 14	29 23	28 28	27 32	26 34	25 31	24 25	23 18	22 11	21 0
6	24	29 44	29 17	28 48	28 14	27 36	26 57	26 14	25 29	24 42	23 54	23 4	22 9	21 11	20 12	19 15	18 13
8	22	25 10	24 43	24 17	23 48	23 16	22 44	22 8	21 30	20 50	20 9	19 27	18 41	17 51	17 2	16 15	15 22
10	20	20 21	19 59	19 38	19 15	19 49	18 24	17 5	17 24	16 51	16 19	15 45	15 7	14 27	13 47	13 8	12 25
12	18	14 26	15 9	14 54	14 37	14 17	13 57	13 34	13 11	13 46	12 23	11 57	11 29	10 57	10 27	9 58	9 25
14	16	10 24	10 13	10 3	9 51	9 37	9 24	9 10	8 54	8 37	8 21	8 4	7 45	7 23	7 3	6 44	6 21
16	14	5 18	5 13	5 9	5 2	4 54	4 48	4 41	4 32	4 24	4 17	4 9	3 58	3 45	3 35	3 27	3 14
18	12	0 9	0 8	0 9	0 8	0 8	0 8	0 7	0 7	0 7	0 9	0 9	0 7	0 5	0 4	0 6	0 4
		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
20	10	5 3	4 58	4 52	4 47	4 42	4 35	4 29	4 21	4 13	4 3	3 57	3 51	3 43	3 33	3 19	3 6
22	8	10 16	10 7	9 54	9 43	9 31	9 17	9 5	8 46	8 29	8 12	7 58	7 42	7 23	7 4	6 39	6 16
24	6	15 27	15 12	14 54	14 37	14 18	13 57	13 37	13 13	12 48	12 20	11 56	11 29	11 11	10 32	9 59	9 26
26	4	20 35	20 15	19 51	19 28	19 2	18 35	18 8	17 36	17 3	16 27	15 53	15 17	14 40	14 1	13 16	12 33
28	2	29 38	25 14	24 44	24 14	23 43	23 8	22 33	21 53	21 13	20 30	19 46	19 1	18 15	17 25	16 30	15 37
2 0	4 0	30 37	30 8	29 33	28 50	28 18	27 37	26 56	26 8	25 19	24 27	23 36	22 42	21 45	20 46	19 42	18 39
8 2	10 28	35 26	34 52	34 13	33 32	32 47	31 59	31 10	30 15	29 19	28 21	27 19	26 17	25 10	24 1	22 48	21 35
4	26	40 8	39 28	38 43	37 57	37 6	36 12	35 17	34 15	33 12	32 6	30 55	29 42	28 28	27 11	25 48	24 26
6	24	44 38	43 54	43 4	42 12	41 15	40 15	39 14	38 4	36 54	35 41	34 21	33 1	31 39	30 12	28 40	27 8
8	22	48 54	48 5	47 11	46 15	45 13	43 6	42 59	41 43	40 26	39 5	37 31	36 10	24 40	33 5	31 24	29 42
10	20	52 57	51 4	51 5	50 3	48 55	47 44	46 32	45 11	43 49	42 25	40 47	39 9	37 32	35 49	33 59	32 9
12	18	56 43	55 45	54 42	53 37	52 23	51 6	49 49	48 22	46 52	45 18	43 38	41 56	40 12	38 21	36 25	34 25
14	16	60 10	59 8	58 1	56 53	55 36	54 14	52 51	51 18	49 43	48 3	46 12	44 28	42 38	40 39	38 34	36 31
16	14	63 17	62 12	61 2	59 50	58 30	57 3	55 36	53 58	52 18	50 33	48 40	46 46	44 59	42 46	40 35	38 22
18	12	66 3	64 55	63 42	62 27	61 2	59 32	58 0	56 18	54 34	52 45	50 47	48 39	46 47	44 37	42 29	40 3
20	10	68 26	67 15	65 59	64 41	63 13	61 41	60 6	58 20	56 32	54 39	52 37	50 54	48 28	46 13	43 51	42 29
22	8	70 26	69 14	67 56	66 35	65 5	63 29	61 51	60 2	58 11	56 16	54 10	52 3	49 54	47 36	45 9	42 40
24	6	71 59	70 45	69 25	68 3	66 31	64 54	63 14	61 23	59 29	57 32	55 21	53 10	50 58	48 36	46 8	43 37
26	4	73 6	71 51	70 30	69 6	67 32	65 54	64 13	62 19	60 23	58 22	56 11	53 59	51 46	49 22	46 51	44 18
28	2	73 45	72 30	71 7	69 42	68 8	66 28	64 45	62 50	60 54	58 53	56 40	54 27	52 13	49 48	47 15	44 40
3 0	3 0	74 0	72 44	71 22	69 57	68 22	66 42	64 59	63 4	61 7	59 5	56 53	54 40	52 24	49 58	47 15	44 50
9	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
☉ à ☽'s Ap. 1. equated.		30°	28°	26°	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°	2°	0°

SIGN 7.

SUPPLEMENTAL

SUPPLEMENTAL LUNAR TABLES.

EQUATION of the MEAN to the present ELLIPTIC EQUATION of the MOON's CENTER.

SIGN 5.

Argument. Equated ANOMALY of the MOON; Or, ☽ 3. equated — Ap. ☽ 2. equated.

Arg. ⊙ à ☽'s Apogee, 1. equated.		0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°
s °	s °	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
0	6	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6 0	12 0	46 2	43 21	40 38	37 48	34 53	31 55	28 55	25 48	22 41	19 31	16 19	13 6	9 51	6 35	3 17	0
2	28	45 53	43 13	40 31	37 41	34 46	31 50	28 50	25 43	22 36	19 27	16 16	13 4	9 49	6 32	3 17	0
4	26	45 37	42 58	40 16	37 27	34 33	31 37	28 39	25 33	22 28	19 21	16 10	12 59	9 46	6 30	3 15	0
6	24	45 12	42 34	39 54	37 6	34 14	31 20	28 23	25 19	22 16	19 9	16 1	12 51	9 40	6 27	3 14	0
8	22	44 32	41 56	39 18	36 33	33 44	30 52	27 57	24 57	21 57	18 52	15 57	12 40	9 31	6 21	3 11	0
10	20	43 42	41 8	38 33	35 53	33 6	30 17	27 26	24 27	21 31	18 31	15 29	12 26	9 21	6 13	3 7	0
12	18	42 41	40 12	37 40	35 2	32 20	29 35	26 49	23 55	21 2	18 5	15 8	12 9	9 8	6 5	3 3	0
14	16	41 30	39 4	36 37	34 3	31 25	28 46	26 4	23 15	20 26	17 35	14 42	11 49	8 52	5 54	2 57	0
16	14	40 7	37 45	35 23	32 57	30 23	27 49	25 11	22 26	19 44	17 0	14 12	11 24	8 34	5 42	2 51	0
18	12	38 39	36 24	34 7	31 43	29 15	26 46	24 16	21 38	19 2	16 24	13 42	11 0	8 16	5 31	2 46	0
20	10	36 54	34 45	32 34	30 18	27 57	25 35	23 11	20 40	18 10	15 38	13 4	10 30	7 54	5 15	2 38	0
22	8	35 3	33 0	30 56	28 45	26 32	24 17	22 0	19 38	17 16	14 51	12 25	9 59	7 31	4 59	2 29	0
24	6	33 7	31 10	29 12	27 10	25 3	22 56	20 47	18 32	16 18	14 2	11 44	9 26	7 5	4 42	2 21	0
26	4	30 54	29 5	27 15	25 20	23 22	21 24	19 24	17 18	15 13	13 6	10 57	8 47	6 36	4 22	2 12	0
28	2	28 36	26 56	25 15	23 28	21 39	19 49	17 57	16 1	14 5	12 8	10 48	8 8	6 7	4 4	2 2	0
1 0	5 0	26 10	24 37	23 5	21 28	19 47	18 6	16 25	14 39	12 53	11 6	9 16	7 27	5 36	3 43	1 51	0
7 2	11 28	23 38	22 15	20 51	19 23	17 52	16 21	14 49	13 13	11 39	10 1	8 22	6 43	5 3	3 21	1 41	0
4	26	21 10	19 47	18 33	17 14	15 53	14 32	13 10	11 46	10 22	8 55	7 26	5 58	4 29	2 59	1 30	0
6	24	18 13	17 9	16 6	14 59	13 47	12 36	12 20	10 12	8 59	7 44	6 27	5 10	3 53	2 35	1 18	0
8	22	15 22	14 28	13 35	12 37	11 38	10 39	9 39	8 36	7 34	6 31	5 26	4 22	3 17	2 11	1 6	0
10	20	12 25	11 42	10 59	10 11	9 24	8 36	7 48	6 57	6 8	5 17	4 24	3 32	2 39	1 46	0 54	0
12	18	9 25	8 52	8 19	7 45	7 8	6 33	5 55	5 15	4 39	4 0	3 10	2 41	2 0	1 21	0 41	0
14	16	6 21	5 58	5 37	5 13	4 49	4 25	4 0	3 33	3 8	2 42	2 15	1 49	1 20	0 54	0 28	0
16	14	3 14	3 3	2 53	2 40	2 28	2 16	2 4	1 49	1 36	1 23	1 9	0 56	0 41	0 28	0 15	0
18	12	0 4	0 5	0 6	0 4	0 5	0 5	0 4	0 3	0 4	0 3	0 2	0 2	0 0	0 0	0 1	0
		±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	
20	10	3 6	2 55	2 41	2 30	2 20	2 8	1 56	1 46	1 32	1 18	1 5	0 53	0 42	0 28	0 13	0
22	8	6 16	5 54	5 29	5 6	4 43	4 19	3 55	3 32	3 5	2 39	2 14	1 48	1 23	0 56	0 27	0
24	6	9 25	8 51	8 15	7 42	7 7	6 31	5 53	5 18	4 39	3 59	3 21	2 41	2 3	1 22	0 41	0
26	4	12 35	11 48	11 0	10 16	9 30	8 41	7 51	7 2	6 11	5 20	4 27	3 33	2 42	1 49	0 54	0
28	2	15 37	14 42	13 44	12 48	11 49	10 48	9 46	8 45	7 42	6 39	5 32	4 26	3 21	2 14	1 7	0
2 0	4 0	18 39	17 32	16 23	15 17	14 6	12 53	11 39	10 25	9 11	7 58	6 37	5 17	4 0	2 40	1 19	0
8 2	10 28	21 55	20 18	18 58	17 42	16 19	14 55	13 29	12 4	10 38	9 13	7 40	6 7	4 37	3 5	1 32	0
4	26	24 26	22 58	21 28	20 1	18 28	16 52	15 15	13 39	12 1	10 25	8 40	6 56	5 13	3 29	1 44	0
6	24	27 8	25 31	23 52	22 15	20 31	18 45	16 58	15 10	13 21	11 32	9 37	7 41	5 47	3 53	1 57	0
8	22	29 42	27 57	26 8	24 21	22 28	20 32	18 36	16 38	14 37	12 37	10 30	8 24	6 20	4 15	2 7	0
10	20	32 9	30 15	28 17	26 21	24 18	22 14	20 8	18 0	15 49	13 39	11 22	9 6	6 52	4 35	2 17	0
12	18	34 25	32 23	30 18	28 14	26 1	23 47	21 33	19 16	16 56	14 36	12 11	9 45	7 21	4 55	2 27	0
14	16	36 31	34 22	32 8	29 55	27 36	25 14	22 51	20 25	17 57	15 28	12 55	10 21	7 48	5 13	2 36	0
16	14	38 22	36 7	33 47	31 28	29 1	26 32	24 2	21 29	18 53	16 16	13 34	10 52	8 11	5 28	2 44	0
18	12	40 3	37 42	35 15	32 49	30 16	27 40	25 4	22 24	19 41	16 57	14 9	11 20	8 33	5 42	2 51	0
20	10	42 29	39 3	36 32	34 0	31 21	28 40	25 28	23 13	20 24	17 33	14 39	11 44	8 51	5 54	2 57	0
22	8	42 40	40 11	37 36	35 0	32 17	29 32	26 45	23 55	21 1	18 6	15 7	12 6	9 5	6 4	3 1	0
24	6	43 37	41 4	38 25	35 46	32 59	30 10	27 19	24 25	21 26	18 26	15 23	12 19	9 19	6 13	3 7	0
26	4	44 18	41 41	39 0	36 18	33 29	30 37	27 43	24 47	21 45	18 42	15 36	12 30	9 27	6 19	3 9	0
28	2	44 40	42 3	39 21	36 38	33 47	30 53	27 58	25 0	21 57	18 53	15 46	12 38	9 32	6 23	3 11	0
3 0	3 0	44 50	42 12	39 29	36 45	33 53	30 59	28 4	25 5	22 2	18 57	15 50	12 41	9 34	6 23	3 11	0
9	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
⊙ à ☽'s Ap 1. equated		30°	28°	26°	24°	22°	20°	18°	16°	14°	12°	10°	8°	6°	4°	2°	0°

SIGN 6.

N. B. Whether you solve the *Central* Equation by this Method, or former one of Eccentricities, *you must go back for the other Equations, according to the Newtonia n Theory, and its Improvements.*

SUPPLEMENTAL LUNAR TABLES.

THE foregoing EQUATION of the MEAN to the preſent ELLIPTIC EQUATION is the *Difference* between the *mean* and *preſent* ELLIPTIC EQUATION, conſtructed from the different *Eccentricities* of the *Lunar* Orbit, correſpondent to the reſpective Diſtances of the Sun à Moon's *Apogee* and equated *Anomalies* of the Moon.

USE *of the foregoing* ELLIPTIC EQUATION.

EXAMPLE I. *To find the Moon's Central or Elliptic Equation, anſwerable to* $2^s\ 8^\circ$ *Sun à Moon's Apogee, and* $1^s\ 11^\circ$ *Moon's equated Anomaly?*

Eq. An. ° ′ ″
By *Tab.* p. 66. Agt. $1^s\ 11^\circ$ . . M. Eq. Moon's Center — 3 55 50
☉ à ☽'s Ap. Eq. An.
By *Tab.* p. 91. Agt. $2^s\ 8^\circ$ under $1^s\ 11^\circ$ . . Equation — 31 40

See p. 83, 84. Equation of Moon's Center required . . — 3 24 10

☉ à ☽ Ap.	Undr An.	Equation.	Dif. Incr.
Agt. $2^s\ 8^\circ$	$1^s\ 10^\circ$	— 30′ 58″	+ 1′ 23″ for 2° Incr. An.
	12	— 32 21	

+ 42 . . . . for 1° Incr. An.
— 31′ 40″ Equation, as above.

EXAMPLE II. *To find the Equation of the Moon's Center, correſpondent to* $1^s\ 15^\circ\ 20'$ *Sun à Moon's Apogee, and* $3^s\ 5^\circ\ 44'$ *equated Anomaly?*

Eq. An. ° ′ ″
By *Tab.* p. 67. Agt. $3^s\ 5^\circ\ 44'$ . . M. Eq. Moon's Center — 6 18 26
☉ à ☽ Ap. Eq. An.
By *Tab.* p. 93. Agt. $1^s\ 15^\circ\ 20'$, under $3^s\ 5^\circ\ 44'$ . . Equn. + 7 43

See p. 85. . . Preſent Equation of Moon's Center required — 6 26 9

	☉ à ☽ Ap.	Undr. An.	Equation.	Undr. An.	Equation.
For Agt.	$1^s\ 14^\circ$	$3^s\ 4^\circ$	+ 11′ 18″	$3^s\ 6^\circ$	+ 11′ 16″
	16		+ 5 49		+ 5 55
	+ 2°		Dif. — 5 29 De.		Dif. — 5 21 Decr.

Half . . . 1° — 2 44 } — 3′ 38″ fr. 1ſt — 2 40 } — 3′ 33″ fr. 1ſt.
20′ = $\frac{1}{3}$ of 1° . . : . 20′ — 54 } — 53 }

☉ à ☽ Ap. $1^s\ 15^\circ\ 20'$ given + 7 40 . . . . + 7 43
7 43

An. + 2° + 3 Increaſe Eq.
connect with above { 1° . 44′ $1\frac{1}{2}$ 1 } + 2″ $\frac{1}{2}$ or 3 connect with 7′ 40″ [above.

Given An. 3^s 5 44 + 7′ 43″, Equation as above.

EXAMPLE III. *To find the Central Equation for* $11^s\ 22^\circ\ 18'\ 38''$ *Sun à Moon's Ap. and* $4^s\ 21^\circ\ 27'\ 32''$ *Moon's An.?*

By *Tab.* p. 94. Agt.	☉ à ☽ Ap.	Undr. An.	Equation.	Undr. An.	Equation.
	$11^s\ 22^\circ$	$4^s\ 20^\circ$	+ 56′ 15″	$4^s\ 22^\circ$	+ 54′ 5″
	24		+ 57 7		+ 54 54
	+ 2°		Dif. + 52 Incr.		Dif. + 49 Incr.
	$\frac{1}{2}$ . . . 1°		26		24
	18′ 38″		+ 8		+ 7
☉ à ☽ Ap. given.	11 22 18 38		56 23		54 12
			54 12		

An. + 2° . . . . — 2 11 Decreaſe Eq.
connect with above { 1° . 27′ 32″ — 1 5 — 30 } — 1′ 35″ connect with 56′ 23″ [above.

Given An. $4^s\ 21^\circ\ 27'\ 32''$ + 54′ 48″ Equation required.

☽ An. ° ′ ″
By *Tab.* p. 68. $4^s\ 21^\circ\ 27'\ 32''$ give the M. Eq. ☽'s Center — 4 9 0
Equation from above . . . . + 54 48

Preſent elliptic or central Equation required — 3 48

N. B. In the above EASY METHOD, the *taking out the elliptic Equation in exact Proportion* for 2° either above or under the preſent Deg. of ☉ à ☽ Ap. will cauſe an Error ſometimes of a few Seconds (not exceeding 8 or 10) becauſe the Equat. for Anom. is not proportional to the Change of Sun à Moon's Apogee; but to the Change of *Eccentricity*, now rejected by *ſome Aſtronomers*, for eaſier Computation. The Remedy for which Error (of a few Seconds) is by a ſhort *Interpolation*.

To find the true from the mean Anomaly in any elliptic Orbit, univerſally and correctly?

Let E = Arch of Excentric Anomaly, x = its natural Sine (Rad. = 1) e = Eccentricity of the Orbit (Tranſverſe = 1) and M = Arch of mean Anomaly.

Then, by the Property of the Ellipſis and a Planet's Motion in its Orbit, E + xe = M. And Radius being = Arch of 57°,295779 Deg. E° + $x \times e$ 57°,295779 = M° (where $x \times e$ 57°,295779 = Dif. Degrees between the excentric and mean Anomalies.)

To find the Excentric Anomaly?

You may readily determine it by the *Pen* and a Table of *natural Sines* from the above Equation; aſſuming two different *excentric Anomalies* adding the reſpective Differences, and proportioning the Errors above or under the Degrees of mean Anomaly, ſo as to aſſign a *near* excentric Anomaly, which may be *correctly* determined by a *ſecond Operation*.

Or, to ſolve the *above Equation*, you may proceed thus.

1°. Say, *As Aph. Diſt. : Perib. Diſt. :: Tang.* $\frac{1}{2}$ *M. Anom. : Tang. of an Arch* (nearly $\frac{1}{2}$ true Anom.) *which added to* $\frac{1}{2}$ *M. Anomaly will be a* firſt excentric *Anomaly*; *which, in Orbits not very excentric, or where the mean and excentric Anomalies differ not above* 3 *Degrees, will be ſufficiently correct.*

2° *In Orbits much excentric, add the Log. of Eccentricity to the Log.* 1.7581227 (of 57°,295779 the Degrees of Rad.) *for a* conſtant *Log. for that Orbit*; *to which add the Log. Sine of the 1ſt* approximated *excentric Anomaly, and take the Number of Degrees correſpondent, and ſubtract them from the mean Anomaly for a ſecond approximated excentric Anomaly, whoſe Log. Sine is to be added to the conſt. Log. as before, and a new Number of Degrees taken, which are to be ſubducted from the mean Anomaly, and ſo proceeding till an excentric* Anomaly *and the following Difference being added, ſhall equal the mean Anomaly, when the* excentric *Anomaly will be correct.*

3°. *Then ſay, as Sq. Root Aph. Diſt. : Sq. Root Perib. Diſt. :: Tan.* $\frac{1}{2}$ *correct Excent. An. : Tan.* $\frac{1}{2}$ *true Anomaly, which doubled is the true required.*

Example. The Anomaly of *Mercury* being 70°, and Eccentricity of that Planet's *Orbit* 0,20589 (of 1 the Tranſverſe) to find the true Anomaly of *Mercury*, at that Time?

		Logs.
As Aph. Diſt.	1,20589	9.9186923 co.
To Per. Diſt.	0,79411	9.8998807
So Tan.	35° . $\frac{1}{2}$ M. An.	9.8452268
To Tan.	24° 45′ 17″ . .	9.6637998

		Logs.
	Rad. 57°,295779	1.7581227
	Ecy. . . ,205890	9.3136353
M. An. 70 00 00	Conſt. Log. . .	1.0717580
1. Ex. An. 59 45 17	Log. Sine . . .	9.9364519 +
Dif. — 10 11 27	10°,19094	1.0082099
2. Ex. An. 59 48 33	Log. Sine . .	9.9366923 +
Dif. — 10 11 47	10°,19648	1.0084503
3. Ex. An. 59 48 13	Log. Sine . .	9.9366678 +
Dif. — 10 11 45	10°,19591	1.0084258
4. Ex. An. 59 48 15	Log. Sine . .	9.9366702 +
Dif. — 10 11 $45\frac{1}{4}$	10°,19596	1.0084280
Cor. Ex. An. 59 48 $14\frac{1}{2}$	And the ſame exactly by Propor. of Inc. of Ex. An. and Error, fr. 1 and 2 Operations.	

	Logs.
Now, As $\sqrt{\text{Ap. Dif. } 1{,}20589}$	9.9593461 co.
To $\sqrt{\text{Per. Dif. } 0{,}79411}$	9.9499404
So T. $\frac{1}{2}$ Ex. An. 29° 54′ 7″ 15‴	9.7597224
To T. $\frac{1}{2}$ Tr. An. 25 . 1 . 1 . 12	9.6690089
Doubled . . . 50 . 2 . 2 . 24	*True An. req.*

N. B. *The above Method exceeds all others for its Simplicity, Univerſality, and Exactneſs.*

Whence 19° 57′ 58″ fere, Equation, agreeing with Dr. *Halley*'s Tables.

*** *Compare the above univerſal Method with Mr.* Simpſon's *intricate and limited Correction of* Ward's *Hypotheſis*, (See his Miſc. Tracts fr. p. 48 to p. 57.) *which we ſhall exhibit hereafter.*

N. B. If any Error ſhould happen by the *above Method*, the next Operation will correct it, proving the Truth at laſt.

SUPPLEMENTAL

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. MAYER.

ACCELERATION of the MOON's Mean MOTION: Or Equation of the ☽'s Mean Long.

Yrs b. & fin. Ch.	+ ° ′ ″	Dif. ′ ″
B. 800	1 9 48	5 29
Ch. 700	1 4 19	5 15
600	0 59 4	5 1
500	0 54 3	4 48
400	0 49 15	4 35
300	0 44 40	4 21
200	0 40 19	4 8
100	0 36 11	3 55
0	0 32 16	3 41
S. 100	0 28 35	3 28
Ch. 200	0 25 7	3 14
300	0 21 53	3 1
400	0 18 52	2 47
500	0 16 5	2 34
600	0 13 31	2 21
700	0 11 10	2 7
800	0 9 3	1 54
900	0 7 9	1 41
1000	0 5 28	1 27
1100	0 4 1	1 13
1200	0 2 48	1 1
1300	0 1 47	0 47
1400	0 1 0	0 33
1500	0 0 27	0 20
1600	0 0 7	0 5
1650	0 0 2	0 2
1700	0 0 0	0 0
1750	0 0 0	0 7
1800	0 0 7	0 8
1850	0 0 15	0 12
1900	0 0 27	0 15
1950	0 0 42	0 18
2000	0 1 0	

EQUATION of the NODE and Mean ANOMALY of the MOON.

Argument. Mean Anomaly of the SUN.

The single for the ☊, and double of which Equation for Mean Anom. ☽.

⊙ M. An. °	0 Sig. + ′ ″	D. ″	1 Sig. + ′ ″	D. ″	2 Sig. + ′ ″	D. ″	3 Sig. + ′ ″	D. ″	4 Sig. + ′ ″	D. ″	5 Sig. + ′ ″	D. ″	⊙ M. An. °
0	0 0	11	5 1	9	8 47	6	10 18	0	9 4	5	5 17	10	30
1	0 11	11	5 10	9	8 53	5	10 18	0	8 59	6	5 8	10	29
2	0 22	10	5 19	9	8 58	5	10 18	0	8 53	6	4 58	10	28
3	0 32	10	5 28	9	9 3	6	10 18	1	8 47	6	4 48	10	27
4	0 43	10	5 37	9	9 9	5	10 17	0	8 41	6	4 38	10	26
5	0 53	11	5 46	9	9 14	5	10 17	1	8 35	6	4 28	10	25
6	1 4	10	5 55	8	9 19	4	10 16	1	8 29	7	4 18	10	24
7	1 14	11	6 3	9	9 23	4	10 15	1	8 22	6	4 8	10	23
8	1 25	10	6 12	8	9 27	4	10 14	1	8 16	6	3 58	10	22
9	1 35	10	6 20	8	9 31	4	10 13	1	8 10	7	3 48	10	21
10	1 45	10	6 28	8	9 35	4	10 12	2	8 3	7	3 38	11	20
11	1 55	10	6 36	8	9 39	3	10 10	2	7 56	8	3 27	10	19
12	2 5	10	6 44	8	9 42	4	10 8	2	7 48	7	3 17	11	18
13	2 15	10	6 52	8	9 46	4	10 6	2	7 41	7	3 6	10	17
14	2 25	10	7 0	8	9 50	3	10 4	2	7 34	8	2 56	11	16
15	2 35	10	7 8	8	9 53	3	10 2	3	7 26	8	2 45	10	15
16	2 45	10	7 16	7	9 56	2	9 59	3	7 18	8	2 35	11	14
17	2 55	10	7 23	8	9 58	3	9 56	3	7 10	8	2 24	11	13
18	3 5	10	7 31	7	10 1	2	9 53	3	7 2	8	2 13	11	12
19	3 15	10	7 38	7	10 3	2	9 50	4	6 54	8	2 2	11	11
20	3 25	10	7 45	7	10 5	2	9 46	3	6 46	9	1 51	11	10
21	3 35	9	7 52	6	10 7	2	9 43	4	6 37	8	1 40	11	9
22	3 44	10	7 58	7	10 9	2	9 39	4	6 29	9	1 29	11	8
23	3 54	10	8 5	7	10 11	2	9 35	4	6 20	8	1 18	11	7
24	4 4	10	8 12	6	10 13	1	9 31	4	6 12	9	1 7	11	6
25	4 14	9	8 18	6	10 14	1	9 27	4	6 3	9	0 56	11	5
26	4 23	10	8 24	6	10 15	1	9 23	5	5 54	9	0 45	11	4
27	4 33	9	8 30	6	10 16	1	9 18	4	5 45	9	0 34	11	3
28	4 42	10	8 36	6	10 17	1	9 14	5	5 36	9	0 23	11	2
29	4 52	9	8 42	5	10 18	0	9 9	5	5 27	10	0 12	12	1
30	5 1		8 47		10 18		9 4		5 17		0 0		0
⊙ M. An.	— 11 Sig.	D.	— 10 Sig.	D.	— 9 Sig.	D.	— 8 Sig.	D.	— 7 Sig.	D.	— 6 Sig.	D.	⊙ M. An.

REMARKS on Mr. MAYER's LUNAR TABLES: *To which our* OWN LUNAR TABLES *are reducible in the Mean* PLACES *and* MOTIONS: *See* Examples *farther on.*

HE did not presume (he says) to send his Tables of the *Lunar* Motions into the World, without being thoroughly convinced of their very near, and scarce to be hoped-for nearer Agreement with the Heavens. That *briefly* to tell us, he says, of more than *two hundred* Observations of the Moon made not only in this but in the preceding Age, scarce *ten* were found, from which his Tables differ one *Minute* and a half; a great many of them come nearer than a single Minute, and not one of them all discovered an Error in his Tables of two Minutes. Which as no Tables heretofore published perform the like, the best of them often erring four or five Minutes, he was the more unwilling his Tables should lie any longer concealed; especially, as the most *celebrated Astronomers* of almost every Age have ardently wished for a *perfect Theory* of the Moon (*to which his Tables are said nearly to approach*) on Account of *its singular Use in Navigation.*

Nor, indeed, (he says) do they seem worthy of Publication for the Sake of this *particular Service*, in compleating the Theory only, but also on Account of that *easy* and *expeditious* Method, by which that particular Service from them may be had, in computing the *Longitude* and *Latitude.* For, if you look into other *Tables*, you will find, on Comparison, these larger *Equations* so few in Number, and the Rest of them so small, that there is no Need of having Recourse to the troublesome Method of *interpolating*, nor of making the Computation of the Arguments to *Seconds.* He has constructed these Tables, he says, with Respect to the *Inequalities* of Motions, from that *famous Theory* of the GREAT NEWTON, which that eminent Mathematician *Eulerus* first elegantly reduced to general *analytical Equations.* And, in the resolving of these Equations, after some fruitless Essays by other Methods, he has hit (as he says) upon a particular Method, pretty elegant and concise, which it would be too tedious for him to explain at large in his Preface. For which Reason he has concluded only to give such Hints as may conduce to lay open the *Origin* and *Causes* of the Inequalities exhibited in the *Equation Tables*, so far as it can be done without making Use of Calculations. Of

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. MAYER.

Argument proper.	I. Equation ☽.						II. Equat. ☽.			III. Equat. ☽.			IV. Equat. ☽.			V. Equat. ☽.			Argument proper.
	Argument 1.						Argument 2.			Argument 3.			Argument 4.			Argument 5.			
	Mean Anomaly ☉.						2. ☽ à ☉ + Arg. 1.			2. ☽ à ☉ — Arg. 1.			Arg. 2. — M. An. ☽.			Arg. 3. — M. An. ☽.			
	0	1	2	3	4	5	0	1	2	0	1	2	0	1	2	0	1	2	
							—	—	—	—	—	—	+	+	+	+	+	+	
							6	7	8	6	7	8	6	7	8	6	7	8	
	+	+	+	+	+	+	+	+	+	+	+	+	—	—	—	—	—	—	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	5 31	9 40	11 20	9 58	5 49	0 0	0 27	0 47	0 0	0 31	0 54	0 0	0 54	1 34	0 0	0 36	1 2	30
1	0 12	5 41	9 46	11 20	9 52	5 39	0 1	0 28	0 47	0 1	0 32	0 54	0 2	0 56	1 35	0 1	0 37	1 3	29
2	0 24	5 51	9 52	11 20	9 46	5 28	0 2	0 29	0 48	0 2	0 33	0 55	0 4	0 57	1 36	0 2	0 38	1 3	28
3	0 35	6 1	9 58	11 20	9 39	5 17	0 3	0 29	0 48	0 3	0 34	0 55	0 6	0 59	1 37	0 4	0 39	1 4	27
4	0 47	6 11	10 3	11 19	9 33	5 6	0 4	0 30	0 49	0 4	0 35	0 56	0 8	1 0	1 38	0 5	0 40	1 4	26
5	0 58	6 21	10 9	11 19	9 26	4 55	0 5	0 31	0 49	0 6	0 36	0 56	0 10	1 2	1 39	0 6	0 41	1 5	25
6	1 10	6 30	10 14	11 18	9 19	4 44	0 6	0 31	0 50	0 7	0 37	0 56	0 12	1 3	1 39	0 8	0 42	1 5	24
7	1 21	6 40	10 19	11 17	9 12	4 33	0 7	0 32	0 50	0 8	0 38	0 57	0 13	1 5	1 40	0 9	0 43	1 6	23
8	1 33	6 49	10 24	11 16	9 5	4 22	0 8	0 33	0 50	0 9	0 38	0 57	0 15	1 6	1 41	0 10	0 44	1 6	22
9	1 44	6 58	10 29	11 15	8 58	4 11	0 9	0 34	0 51	0 10	0 39	0 58	0 17	1 8	1 41	0 12	0 45	1 7	21
10	1 55	7 7	10 33	11 13	8 51	3 59	0 10	0 34	0 51	0 11	0 40	0 58	0 19	1 9	1 42	0 13	0 46	1 7	20
11	2 7	7 16	10 37	11 11	8 43	3 48	0 11	0 35	0 51	0 12	0 41	0 58	0 21	1 10	1 42	0 14	0 47	1 8	19
12	2 18	7 25	10 41	11 9	8 35	3 36	0 12	0 36	0 52	0 13	0 42	0 59	0 23	1 12	1 43	0 16	0 48	1 8	18
13	2 29	7 34	10 45	11 7	8 27	3 25	0 13	0 37	0 52	0 14	0 42	0 59	0 24	1 13	1 44	0 17	0 49	1 9	17
14	2 40	7 42	10 49	11 5	8 19	3 13	0 13	0 37	0 52	0 15	0 43	1 0	0 26	1 15	1 44	0 18	0 50	1 9	16
15	2 51	7 51	10 52	11 2	8 11	3 1	0 14	0 38	0 52	0 16	0 44	1 0	0 28	1 16	1 45	0 19	0 51	1 10	15
16	3 2	7 59	10 55	10 59	8 3	2 50	0 15	0 39	0 52	0 17	0 45	1 0	0 30	1 18	1 45	0 20	0 52	1 10	14
17	3 13	8 7	10 58	10 56	7 54	2 38	0 16	0 39	0 53	0 18	0 45	1 0	0 32	1 19	1 46	0 22	0 52	1 10	13
18	3 24	8 15	11 1	10 52	7 45	2 26	0 17	0 40	0 53	0 19	0 46	1 1	0 33	1 20	1 46	0 23	0 53	1 11	12
19	3 35	8 23	11 3	10 49	7 36	2 14	0 18	0 41	0 53	0 20	0 47	1 1	0 35	1 22	1 46	0 24	0 54	1 11	11
20	3 46	8 31	11 6	10 45	7 27	2 2	0 19	0 41	0 53	0 21	0 48	1 1	0 37	1 23	1 47	0 25	0 55	1 11	10
21	3 57	8 39	11 8	10 41	7 18	1 50	0 19	0 42	0 53	0 22	0 48	1 1	0 39	1 24	1 47	0 26	0 56	1 11	9
22	4 8	8 46	11 10	10 37	7 9	1 38	0 20	0 42	0 53	0 23	0 49	1 1	0 41	1 26	1 47	0 28	0 56	1 11	8
23	4 18	8 54	11 12	10 33	7 0	1 26	0 21	0 43	0 53	0 24	0 50	1 1	0 42	1 27	1 47	0 29	0 57	1 11	7
24	4 29	9 1	11 14	10 29	6 50	1 14	0 22	0 44	0 54	0 25	0 50	1 2	0 44	1 28	1 47	0 30	0 58	1 12	6
25	4 40	9 8	11 16	10 24	6 40	1 1	0 23	0 44	0 54	0 26	0 51	1 2	0 46	1 29	1 48	0 31	0 59	1 12	5
26	4 50	9 1[illegible]	11 17	10 19	6 30	0 49	0 23	0 45	0 54	0 27	0 51	1 2	0 48	1 30	1 48	0 32	0 59	1 12	4
27	5 0	9 21	11 18	10 14	6 20	0 37	0 24	0 45	0 54	0 28	0 52	1 2	0 49	1 31	1 48	0 33	1 0	1 12	3
28	5 11	9 28	11 19	10 9	6 9	0 25	0 25	0 46	0 54	0 29	0 52	1 2	0 51	1 32	1 48	0 34	1 1	1 12	2
29	5 21	9 34	11 20	10 4	5 59	0 13	0 26	0 46	0 54	0 30	0 53	1 2	0 52	1 33	1 48	0 35	1 1	1 12	1
30	5 31	9 40	11 20	9 58	5 49	0 0	0 27	0 47	0 54	0 31	0 54	1 2	0 54	1 34	1 48	0 36	1 2	1 12	0
	—	—	—	—	—	—	+	+	+	+	+	+	—	—	—	—	—	—	
							11	10	9	11	10	9	11	10	9	11	10	9	
							—	—	—	—	—	—	+	+	+	+	+	+	
	11	10	9	8	7	6	5	4	3	5	4	3	5	4	3	5	4	3	
	Argument as above.					or	2. ☽ à ☉ + ☉ M. An.			2. ☽ à ☉ — ☉ M. An.			2. ☽ à ☉ + ☉ An. — ☽ An.			2. ☽ à ☉ — ☉ An. — ☽ An.			
Argument proper.	I. Equation ☽.						II. Equat. ☽.			III. Equat. ☽.			IV. Equat. ☽.			V. Equat. ☽.			Argument proper.

Of Mr. MAYER's LUNAR EQUATIONS *and* MOTIONS.

According to Mr. *Mayer*, the Moon's Motion in *Longitude* ought to be corrected by XIII Equations; the most considerable of which are the XI, XII, and XIII; on which almost all the Rest depend. The XI, otherwise called the Equation of the *Moon's Center*, proceeds from the *Eccentricity* of the Moon's Orbit, and follows the *Keplerian* Law. Its Quantity is not ascertained by the *Theory* itself, but must be determined by immediate Observations; and is the only one, he thinks, that may not be affected by the Sun's Action.

The XII. *Equation* is derived from the Power of the *Sun* upon the *Moon*, and the Eccentricity of the *Lunar* Orbit, jointly, and would vanish, was either the Sun's Action to cease, or the Moon's Orbit to become perfectly circular. This *Equation*, or rather one like it, *Bullialdus*, and some others, called the *Evection*. It strictly follows the *Keplerian* Law, except that it is variable from a twofold Cause. The *first* is the unequal Distances of the *Sun* from the *Earth*; for when the Sun is in *Apogeon*, the EVECTION will be less, and when in *Perigeon*, almost as much greater. The *second* Cause is the mutable Distance of the *Moon* from the *Earth*, which at the Moon's *Perigeon* makes the Equation greater, and in its *Apogeon* less. The mean Quantity thereof is indeed that set down in the following Equation *Tables*; but then that Part which is, for the aforementioned Cause, variable, is restored by the IV, V, X, and also some Part of the XIII. Equation, from whence the Reason of those Equations may be known.

By these two *Equations*, the XI and XII, the same Inequalities are regulated, which NEWTON, and those who have closely followed him, have explained by the variable *Eccentricity* of the Moon's Orbit, and the unequal Motion of the *Apsides*. And though that *Method*, Mr. *Mayer* afferts,

SUPPLEMENTAL

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. MAYER.

Argument proper.	VI. Equat. ☽.			VII. Equat. ☽.			VIII. Eq. ☽.			IX. Equat. ☽.			X. Equation ☽.						Argument proper.
	Argument 6.			Argument 7.			Argument 8.			Argument 9.			Argument 10.						
	2. ☽ à ⊙ + M. An. ☽.			2. ☽ à ☊ — M. An. ☽.			M. An. ☽ — Arg. 1.			☊Pl. — ⊙Pl. true			☽ à ⊙ — M. Anom. ☽.						
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	3	4	5	
	+	+	+	+	+	+	+	+	+	+	+	+							
	6	7	8	6	7	8	6	7	8	6	7	8							
	—	—	—	—	—	—	—	—	—	+	+	+	+	+	+	±	—	—	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	0 45	1 18	0 0	0 29	0 50	0 0	0 20	0 35	0 0	0 41	0 41	0 0	3 11	3 22	0 29	2 32	2 42	30
1	0 2	0 46	1 19	0 1	0 30	0 50	0 1	0 20	0 35	0 2	0 41	0 40	0 8	3 15	3 19	0 22	2 35	2 39	29
2	0 3	0 48	1 19	0 2	0 31	0 51	0 2	0 21	0 36	0 3	0 42	0 39	0 15	3 19	3 15	0 15	2 39	2 36	28
3	0 5	0 49	1 20	0 3	0 31	0 51	0 2	0 21	0 36	0 5	0 43	0 38	0 23	3 22	3 11	0 8	2 42	2 32	27
4	0 6	0 51	1 20	0 4	0 32	0 52	0 3	0 22	0 36	0 6	0 43	0 37	0 30	3 25	3 7	0 1	2 45	2 28	26
5	0 8	0 52	1 21	0 5	0 33	0 52	0 4	0 23	0 37	0 8	0 44	0 36	0 38	3 28	3 3	0 6	2 48	2 24	25
6	0 9	0 53	1 22	0 6	0 34	0 53	0 4	0 23	0 37	0 10	0 44	0 35	0 45	3 31	2 58	0 13	2 51	2 20	24
7	0 11	0 55	1 22	0 7	0 35	0 53	0 5	0 24	0 37	0 11	0 45	0 34	0 53	3 33	2 53	0 20	2 53	2 15	23
8	0 13	0 56	1 23	0 8	0 35	0 54	0 6	0 24	0 37	0 13	0 45	0 32	1 0	3 36	2 48	0 27	2 55	2 11	22
9	0 14	0 57	1 23	0 9	0 36	0 54	0 6	0 25	0 38	0 14	0 46	0 31	1 8	3 38	2 43	0 34	2 57	2 6	21
10	0 16	0 58	1 24	0 10	0 37	0 54	0 7	0 26	0 38	0 16	0 46	0 30	1 15	3 40	2 38	0 41	2 59	2 1	20
11	0 17	0 59	1 25	0 11	0 38	0 55	0 7	0 26	0 38	0 17	0 46	0 29	1 22	3 42	2 32	0 48	3 0	1 56	19
12	0 19	1 1	1 25	0 12	0 38	0 55	0 8	0 27	0 38	0 19	0 47	0 27	1 29	3 43	2 27	0 54	3 1	1 51	18
13	0 20	1 2	1 26	0 13	0 39	0 55	0 9	0 27	0 38	0 20	0 47	0 26	1 36	3 44	2 21	1 1	3 2	1 46	17
14	0 22	1 3	1 26	0 14	0 40	0 56	0 9	0 28	0 38	0 22	0 47	0 25	1 43	3 44	2 16	1 8	3 3	1 40	16
15	0 23	1 4	1 27	0 15	0 41	0 56	0 10	0 28	0 39	0 23	0 47	0 23	1 50	3 45	2 10	1 14	3 4	1 35	15
16	0 25	1 5	1 27	0 16	0 41	0 56	0 11	0 29	0 39	0 25	0 47	0 22	1 56	3 45	2 4	1 20	3 4	1 29	14
17	0 26	1 6	1 28	0 17	0 42	0 56	0 11	0 29	0 39	0 26	0 47	0 20	2 3	3 44	1 58	1 26	3 3	1 23	13
18	0 28	1 7	1 28	0 18	0 43	0 57	0 12	0 30	0 39	0 27	0 47	0 19	2 9	3 44	1 51	1 32	3 3	1 17	12
19	0 29	1 8	1 28	0 19	0 43	0 57	0 13	0 30	0 39	0 29	0 46	0 17	2 15	3 43	1 45	1 38	3 2	1 11	11
20	0 31	1 9	1 29	0 20	0 44	0 57	0 13	0 31	0 39	0 30	0 46	0 16	2 21	3 43	1 38	1 44	3 2	1 5	10
21	0 32	1 10	1 29	0 21	0 45	0 57	0 14	0 31	0 39	0 31	0 46	0 14	2 26	3 42	1 32	1 49	3 1	0 59	9
22	0 34	1 11	1 29	0 22	0 45	0 57	0 15	0 32	0 40	0 32	0 45	0 13	2 32	3 41	1 25	1 55	3 0	0 53	8
23	0 35	1 12	1 29	0 23	0 46	0 58	0 15	0 32	0 40	0 34	0 45	0 11	2 37	3 39	1 18	2 0	2 59	0 46	7
24	0 37	1 13	1 29	0 24	0 46	0 58	0 16	0 33	0 40	0 35	0 44	0 10	2 43	3 37	1 11	2 5	2 57	0 40	6
25	0 38	1 14	1 30	0 25	0 47	0 58	0 17	0 33	0 40	0 36	0 44	0 8	2 48	3 35	1 4	2 10	2 55	0 33	5
26	0 39	1 15	1 30	0 26	0 47	0 58	0 17	0 34	0 40	0 37	0 43	0 6	2 53	3 33	0 57	2 15	2 53	0 27	4
27	0 41	1 16	1 30	0 27	0 48	0 58	0 18	0 34	0 40	0 38	0 43	0 5	2 58	3 30	0 50	2 19	2 50	0 20	3
28	0 42	1 16	1 30	0 27	0 49	0 58	0 19	0 34	0 40	0 39	0 42	0 3	3 2	3 28	0 43	2 24	2 48	0 14	2
29	0 44	1 17	1 30	0 28	0 49	0 58	0 19	0 35	0 40	0 40	0 41	0 2	3 7	3 25	0 36	2 28	2 45	0 7	1
30	0 45	1 18	1 30	0 29	0 50	0 58	0 20	0 35	0 40	0 41	0 41	0 0	3 11	3 22	0 29	2 32	2 42	0 0	0
Argument proper.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	∓	+	+	Argument proper.
	11	10	9	11	10	9	11	10	9	11	10	9							
	+	+	+	+	+	+	+	+	+	—	—	—							
	5	4	3	5	4	3	5	4	3	5	4	3	11	10	9	8	7	6	
	Arg. As above. or			As above.			M. An. ☽ — M. An. ⊙.			As above.			As above.						
	VI. Equat. ☽.			VII. Equat. ☽.			VIII. Eq. ☽.			IX. Equat. ☽.			X. Equation ☽.						

Of Mr. MAYER's Lunar Equations *and* Motions.

asserts, exactly corresponds with the *Theory*, yet he thinks it is a little the more difficult, and not so well adapted to a *tabular* Computation. For which Reason, he says, the *Lunar Astronomy* is highly indebted to the celebrated *Eulerus*, who first elegantly substituted the constant Equation of the *Center* together with that which is called the *Evection*, in the Room of the variable *Eccentricity*, and so adorned the *Lunar* Theory, which was otherwise extremely intricate, with a *neat and elegant Contraction: omitting 2d large Equation ☽'s Apogee.*

The XIII. Equation was first discovered by *Tycho*, who gave it the Name of the Variation; *Bullialdus*, and others, call it the Reflection. The *Theory* itself plainly enough determines its Quantity, arising from the Action of the Sun singly, so that it would remain, if the Orbits both of the Moon and Earth had no Eccentricity. Some Part of it depends on the Quantity of the Sun's *Parallax*, which Mr. *Mayer* assumed $= 11''\frac{1}{2}$, which he thinks not wide of Truth. It is here to be noted, that the mean Quantity of this Equation (which by Reason of the different Distances of the Sun and Moon from the Earth making it variable like the foregoing) is exactly equal to half the *Evection*; which, though not absolutely necessary, so far as may be discovered from the *Theory*, yet he thinks should not be wholly ascribed to Chance. But the Changes it undergoes, from the different Distances of the Sun, are contained in the II. and III. Equations; and those which happen on Account of the Inequality of the Moon's Distance from the Earth, are accounted for in the VI. Equation, and in some Part of the XII.

The *first* Equation of the *Moon's Longitude* is derived from the Sun's Action and also from the Eccentricity of the Earth's Orbit. For if these were both destroyed, the Equation would vanish with them. The Nature of this Equation is such, that it accelerates the Moon's Motion

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Conſtruction of Mr. MAYER.

XI. MEAN EQUATION of the MOON's CENTER.

Argument 11. MOON's Mean Anomaly, corrected by the 11 preceding Equations.

☽ cor. An.	Sig. 0. —	Sig. 0. Dif.	Sig. 1. —	Sig. 1. Dif.	Sig. 2. —	Sig. 2. Dif.	Sig. 3. —	Sig. 3. Dif.	Sig. 4. —	Sig. 4. Dif.	Sig. 5. —	Sig. 5. Dif.	☽ cor. An.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0	6 11	2 58 33	5 28	5 16 28	3 27	6 17 50	0 24	5 39 0	3 7	3 21 4	6 0	30
1	0 6 11	6 11	3 4 1	5 25	5 19 55	3 22	6 18 14	0 17	5 35 53	3 13	3 15 4	6 3	29
2	0 12 22	6 10	3 9 26	5 22	5 23 17	3 17	6 18 31	0 10	5 32 40	3 20	3 9 1	6 7	28
3	0 18 32	6 10	3 14 48	5 19	5 26 34	3 12	6 18 41	0 3	5 29 20	3 27	3 2 54	6 11	27
4	0 24 42	6 10	3 20 7	5 17	5 29 46	3 7	6 18 44	0 4	5 25 53	3 32	2 56 43	6 15	26
5	0 30 52	6 10	3 25 24	5 14	5 32 53	3 1	6 18 40	0 11	5 22 21	3 39	2 50 28	6 19	25
6	0 37 2	6 9	3 30 38	5 10	5 35 54	2 55	6 18 29	0 18	5 18 42	3 46	2 44 9	6 22	24
7	0 43 11	6 8	3 35 48	5 7	5 38 49	2 49	6 18 11	0 25	5 14 56	3 52	2 37 47	6 26	23
8	0 49 19	6 8	3 40 55	5 3	5 41 38	2 43	6 17 46	0 32	5 11 4	3 59	2 31 21	6 30	22
9	0 55 27	6 7	3 45 58	4 59	5 44 21	2 37	6 17 14	0 38	5 7 5	4 6	2 24 51	6 33	21
10	1 1 54	6 6	3 50 57	4 56	5 46 58	2 31	6 16 36	0 46	5 2 59	4 12	2 18 18	6 36	20
11	1 7 40	6 5	3 55 53	4 52	5 49 29	2 26	6 15 50	0 53	4 58 47	4 18	2 11 42	6 38	19
12	1 13 45	6 3	4 0 45	4 49	5 51 55	2 20	6 14 57	1 0	4 54 29	4 24	2 5 4	6 41	18
13	1 19 48	6 2	4 5 34	4 45	5 54 15	2 14	6 13 57	1 7	4 50 5	4 29	1 58 23	6 44	17
14	1 25 50	6 2	4 10 19	4 41	5 56 29	2 8	6 12 50	1 14	4 45 36	4 35	1 51 39	6 47	16
15	1 31 52	6 0	4 15 0	4 37	5 58 37	2 2	6 11 36	1 21	4 41 1	4 41	1 44 52	6 49	15
16	1 37 52	5 58	4 19 37	4 33	6 0 39	1 55	6 10 15	1 28	4 36 20	4 47	1 38 3	6 51	14
17	1 43 50	5 57	4 24 10	4 28	6 2 34	1 49	6 8 47	1 35	4 31 33	4 54	1 31 12	6 54	13
18	1 49 47	5 55	4 28 38	4 24	6 4 23	1 43	6 7 12	1 43	4 26 39	4 59	1 24 18	6 55	12
19	1 55 42	5 53	4 33 2	4 20	6 6 6	1 37	6 5 29	1 50	4 21 40	5 6	1 17 23	6 56	11
20	2 1 35	5 51	4 37 22	4 16	6 7 43	1 30	6 3 39	1 57	4 16 24	5 11	1 10 27	6 58	10
21	2 7 26	5 49	4 41 38	4 11	6 9 13	1 24	6 1 42	2 4	4 11 23	5 16	1 3 29	6 59	9
22	2 13 15	5 47	4 45 49	4 6	6 10 37	1 17	5 59 38	2 10	4 6 7	5 21	0 56 30	7 1	8
23	2 19 2	5 46	4 49 55	4 2	6 11 54	1 11	5 57 28	2 17	4 0 46	5 25	0 49 29	7 2	7
24	2 24 48	5 44	4 53 57	3 58	6 13 5	1 5	5 55 11	2 24	3 55 21	5 30	0 42 27	7 4	6
25	2 30 32	5 42	4 57 55	3 53	6 14 10	0 58	5 52 47	2 31	3 49 51	5 35	0 35 23	7 4	5
26	2 36 14	5 39	5 1 48	3 48	6 15 8	0 51	5 50 16	2 38	3 44 16	5 40	0 28 19	7 4	4
27	2 41 53	5 36	5 5 36	3 43	6 15 59	0 44	5 47 38	2 45	3 38 36	5 46	0 21 15	7 5	3
28	2 47 29	5 33	5 9 19	3 37	6 16 43	0 37	5 44 53	2 53	3 32 50	5 50	0 14 10	7 5	2
29	2 53 2	5 31	5 12 56	3 32	6 17 20	0 30	5 42 0	3 0	3 27 0	5 56	0 7 5	7 5	1
30	2 58 33		5 16 28		6 17 50		5 39 0		3 21 4		0 0 0		0
☽ cor. An.	+	Dif.	+	Dif.	+	Dif.	+	Dif.	+	Dif.	+	Dif.	☽ cor. An.
	Sig. 11.		Sig. 10.		Sig. 9		Sig. 8.		Sig. 7.		Sig. 6.		

Of Mr. MAYER's LUNAR EQUATIONS *and* MOTIONS.

Motion when the Sun is in *Apogeon*, and retards it, when the Sun is in *Perigeon*. It has paſſed under various Names both in this and the laſt Age; but its true Quantity, which the *Theory* leaves in ſome Meaſure doubtful, Mr. *Mayer* has reſtored from a great Number of Obſervations. And as this Equation is variable (which no one, before him, ſeems to have taken due Notice of) by Reaſon of the variable Diſtances of the ☽ from the Earth, he therefore found it neceſſary to add the VIII. EQUATION, though that Equation does not wholly account for the Change. The other Part is excellently reſtored by that *Equation*, which is to be applied to the *mean Anomaly*, and which alſo contains the Inequality of the Motion of the *Apogeon*, ſo far as that varies on Account of the greater or leſs Diſtance of the Sun from the Earth.

The VII. and IX. EQUATIONS cannot ſo eaſily be explained in Words without a *Calculus*: But it may be ſufficient to obſerve, he ſays, that they ariſe from the *Inclination* of the Moon's *Orbit* to the Ecliptic, which is the Cauſe, that the Sun ſometimes acts obliquely on the Moon and ſo affects its Motion in *Longitude* a little: Add to this, the *Eccentricity* of the Moon's Orbit, which makes the Sun's Action greater when the Moon is near its *Apogeon*, and leſs, when in its *Perigeon*. There are, 'tis true, ſome other *Inequalities* affecting the Moon's Motion in *Longitude*, which he has not mentioned. But then ſome of them are united with the Equations above mentioned; others are preſerved by the Equation he applied to the mean Anomaly; and others there are, which he has entirely neglected. The Reduction Equation to the *Ecliptic*, or the XIV. EQUATION of *Longitude*, he has fixed as invariable, though the *Inclination of the Orbit*, whence it ariſes, is not always the ſame. But if the VARIATION or XIII. *Equation* be ſomewhat diminiſhed, as has been done, and requires Notice ſhould be taken thereof, it amounts to the ſame, and is more commodious than if this *Reduction* Equation had been made variable. This he particularly mentions, that no Body may in this Place *abſurdly* ſeek out Errors, of which he may think the Tables themſelves *not yet clear*. He has formed two Tables to determine the *Moon's Latitude*, one containing its mean Quantity, independent of the Sun's Action; the other containing the *Variations of Latitude* ariſing therefrom.

If this *ſecond Latitude* Table, as it may be named, be made variable in the *reciprocal triplicate Ratio* of the Sun's Diſtance from the Earth, it will, perhaps, come ſomewhat nearer the Truth. But ſtill there are other Irregularities in the ☽'s *Latitude*, not yet diſcovered, that Correction of them, as well as of all thoſe yet unknown in the *Theory*, is uſeleſs, till we gain more accurate Obſervations of the Latitude, which may be now more carefully performed, he thinks, by Means of the more exact *Parallax* of the Moon aſcertained at the End of theſe *Equation Tables*.

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. MAYER.

XII. EQUATION of the MOON's EVECTION, or Second Equation of the MOON's CENTER.

Arg. 12. Or 2. ☽ à ☉ cor^d. by ☽'s Pl. at 10 Eq. (not at 11th, of which this Eq. is 2d. Part) — M. An. cor^d. or Arg. 11th.

evection.	Sig. 0. —	Dif.	Sig. 1. —	Dif.	Sig. 2. —	Dif.	Sig. 3. —	Dif.	Sig. 4. —	Dif.	Sig. 5. —	Dif	evection.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0		0 39 50		1 9 22		1 20 42		1 10 24		0 40 52		30
1	0 1 24	1 24	0 41 2	1 12	1 10 4	0 42	1 20 43	0 1	1 9 42	0 42	0 39 38	1 14	29
2	0 2 47	1 23	0 42 14	1 12	1 10 45	0 41	1 20 42	0 1	1 8 58	0 44	0 38 23	1 15	28
3	0 4 10	1 23	0 43 25	1 11	1 11 25	0 40	1 20 39	0 3	1 8 13	0 45	0 37 7	1 16	27
4	0 5 33	1 23	0 44 35	1 10	1 12 4	0 39	1 20 35	0 4	1 7 27	0 46	0 35 50	1 17	26
5	0 6 56	1 23	0 45 44	1 9	1 12 41	0 37	1 20 30	0 5	1 6 40	0 47	0 34 33	1 17	25
6	0 8 19	1 23	0 46 52	1 8	1 13 17	0 36	1 20 23	0 7	1 5 52	0 48	0 33 15	1 18	24
7	0 9 42	1 23	0 47 59	1 7	1 13 51	0 34	1 20 15	0 8	1 5 2	0 50	0 31 57	1 18	23
8	0 11 5	1 23	0 49 6	1 7	1 14 24	0 33	1 20 5	0 10	1 4 11	0 51	0 30 38	1 19	22
9	0 12 27	1 22	0 50 12	1 6	1 14 56	0 32	1 19 54	0 11	1 3 18	0 53	0 29 19	1 19	21
10	0 13 49	1 22	0 51 17	1 5	1 15 27	0 31	1 19 41	0 13	1 2 24	0 54	0 27 59	1 20	20
11	0 15 11	1 22	0 52 21	1 4	1 15 50	0 29	1 19 27	0 14	1 1 29	0 55	0 26 38	1 21	19
12	0 16 33	1 22	0 53 24	1 3	1 16 24	0 28	1 19 11	0 16	1 0 33	0 56	0 25 17	1 21	18
13	0 17 54	1 21	0 54 26	1 2	1 16 50	0 26	1 18 54	0 17	0 59 36	0 57	0 23 55	1 22	17
14	0 19 15	1 21	0 55 27	1 1	1 17 15	0 25	1 18 35	0 19	0 58 38	0 58	0 22 33	1 22	16
15	0 20 36	1 21	0 56 28	1 1	1 17 30	0 24	1 18 15	0 20	0 57 39	0 59	0 21 11	1 22	15
16	0 21 56	1 20	0 57 28	1 0	1 18 1	0 22	1 17 53	0 22	0 56 39	1 0	0 19 48	1 23	14
17	0 23 16	1 20	0 58 26	0 58	1 18 22	0 21	1 17 30	0 23	0 55 38	1 1	0 18 25	1 23	13
18	0 24 35	1 19	0 59 23	0 57	1 18 41	0 19	1 17 6	0 24	0 54 36	1 2	0 17 1	1 24	12
19	0 25 54	1 19	1 0 19	0 56	1 18 59	0 18	1 16 40	0 20	0 53 32	1 4	0 15 37	1 24	11
20	0 27 13	1 19	1 1 14	0 55	1 19 16	0 17	1 16 13	0 27	0 52 27	1 5	0 14 13	1 24	10
21	0 28 31	1 18	1 2 8	0 54	1 19 31	0 15	1 15 44	0 29	0 51 21	1 6	0 12 48	1 25	9
22	0 29 49	1 18	1 3 1	0 53	1 19 45	0 14	1 15 14	0 30	0 50 15	1 6	0 11 23	1 25	8
23	0 31 6	1 17	1 3 53	0 52	1 19 57	0 12	1 14 43	0 31	0 49 8	1 7	0 9 58	1 25	7
24	0 32 23	1 17	1 4 44	0 51	1 20 8	0 11	1 14 10	0 33	0 48 0	1 8	0 8 33	1 25	6
25	0 33 39	1 16	1 5 33	0 49	1 20 17	0 9	1 13 35	0 34	0 46 51	1 9	0 7 8	1 25	5
26	0 34 54	1 15	1 6 21	0 48	1 20 25	0 8	1 13 0	0 36	0 45 41	1 10	0 5 43	1 25	4
27	0 36 9	1 15	1 7 8	0 47	1 20 31	0 6	1 12 23	0 37	0 44 30	1 11	0 4 18	1 25	3
28	0 37 23	1 14	1 7 54	0 46	1 20 36	0 5	1 11 45	0 38	0 43 18	1 12	0 2 52	1 26	2
29	0 38 37	1 14	1 8 39	0 45	1 20 40	0 4	1 11 5	0 40	0 42 5	1 13	0 1 26	1 26	1
30	0 39 50	1 13	1 9 22	0 43	1 20 42	0 2	1 10 24	0 41	0 40 52	1 13	0 0 0	1 26	0
evection.	+ Sig. 11.	Dif.	+ Sig. 10.	Dif.	+ Sig. 9.	Dif.	+ Sig. 8.	Dif	+ Sig. 7.	Dif.	+ Sig. 6.	Dif.	evection.

Of Mr. MAYER's LUNAR EQUATIONS and MOTIONS.

He, not being furnished with such accurate Observations, could not promise that the Latitude found by his Tables will come nearer than *one* *Minute*: but, in *Eclipses*, the Error, he asserts, will not amount to 20″. And how plain and easy the *Method* of computing the *Latitude* is by Tables thus contrived, *(like our own for Facility)* and how different from all Methods heretofore laid down, is too evident to require making Mention.

In settling the mean Motion of the *Moon* he has endeavoured to arrive at some Degree of Certainty, as well as Agreement with the Observations of ancient Times. He has examined the earliest Observations of the *Lunar Eclipses* made by the *Babylonians*, as well as *Hipparchus*, and *Ptolemy*; though they are so gross and incorrect, that he in vain attempted to bring them tolerably near their Times, by the *Tables*; but this will not appear strange to any one, who considers, that the *Ancients*, in observing the Times of these *Phænomena*, did not much regard a Quarter or Half an Hour. Besides which there is great Reason to suspect, that *Ptolemy*, from whom we have the Accounts of these *Eclipses*, has too boldly altered the Times of some, and adapted them to the Numbers of his own *Hypotheses*. Instances of which are produced by *Ismael* *Bullialdus*, in the *Astron. Philol.* B. III. C. 7. For this Reason no Body will impute it as a Fault in Mr. *Mayer*, if his *Tables* should be found in the Calculation of one or two of those *Eclipses*, not to come within half an Hour. But, notwithstanding this *Difference*, arising either from the Negligence of the *Antients*, or the Unfaithfulness of PTOLEMY, these Observations have concurrently shewn, that the Moon's Motion of old was sensibly *slower* than it is discovered to be in our Age. *Halley*, and some other Astronomers, have taken Notice of this *Acceleration* in the Moon's Motion; but the Quantity thereof has scarcely been well ascertained by any one. In Order there ore to determine it the *more* *accurately*, Mr. *Mayer* has, with great Pains and Assiduity, examined the Observations made between those of *Ptolemy* and our Time; *viz.* those of *Albategnius* and other *Arabian* Astronomers. Among which he found two Observations of *solar Eclipses*, that because of some singular Circumstances attending them, *the Sun's Altitude taken at their Beginning and End*, ought, in his Judgment, to be accounted more valuable than *Gold and* *Silver*. He does not remember that any of these *Gentlemen* who compiled Tables of the Moon's Motion, having made any Use of these Observations; though probably more Advantage might be reaped from those alone than from all the Observations of *Ptolemy*. For which Reason, and as they are particularly useful to demonstrate the *Acceleration* of the Moon's Motion, he thought them worthy of a Place, and so copied them, as follows, from the *Prolegomena* of *Tycho's Historia Cœlestis*, where they have hitherto lain hid among others of less Account.

" *In the Year of* Mahomet's *Flight* 367, *on* Thursday *the* 28*th of the latter Month* Rabia, *was observed at* Grand Cairo, *the* Metropolis *of* " Egypt, *the Beginning of an Eclipse of the Sun, which, at that Time, was* 15°. 43′. *high, the Quantity of the Obscuration* 8 *Digits*; *at the* " *End the Sun's Altitude was* 33°. ¼. *The same Year, on* Sunday *the* 29*th of the Month* Sywal *the Sun was eclipsed* 7 ½ *Digits*; *at the Begin-*

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. MAYER.

XIII. EQUATION of the MOON's VARIATION.

☽ eq^d. à ☉.	*Argument* 13. ☽ equated from the SUN; or ☽'s Pl. equated — ☉'s Pl. true.												☽ eq^d. à ☉.
	Sign 0.		Sign 1.		Sig. 2.		Sig. 3.		Sig. 4.		Sig. 5.		
	+	Dif.	+	Dif.	±	Dif.	+	Dif.	+	Dif.	+	Dif.	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	1 24	34 17	0 39	33 2	0 45	1 57	1 24	36 21	0 40	36 8	0 45	30
1	1 24	1 24	34 56	0 36	32 17	0 47	3 21	1 23	37 1	0 38	35 23	0 47	29
2	2 48	1 23	35 32	0 33	31 30	0 50	4 44	1 23	37 39	0 35	34 36	0 50	28
3	4 11	1 23	36 5	0 30	30 40	0 53	6 7	1 22	38 14	0 33	33 46	0 52	27
4	5 34	1 23	36 35	0 27	29 47	0 55	7 29	1 22	38 47	0 30	32 54	0 55	26
5	6 57	1 22	37 2	0 24	28 52	0 57	8 51	1 21	39 17	0 27	31 59	0 57	25
6	8 19	1 21	37 26	0 22	27 55	0 59	10 12	1 21	39 44	0 24	31 2	0 59	24
7	9 40	1 21	37 48	0 19	26 56	1 0	11 33	1 20	40 8	0 22	30 3	1 2	23
8	11 1	1 20	38 7	0 17	25 56	1 2	12 53	1 20	40 30	0 19	29 1	1 4	22
9	12 21	1 19	38 24	0 14	24 54	1 4	14 13	1 19	40 49	0 16	27 57	1 6	21
10	13 40	1 18	38 38	0 11	23 50	1 6	15 32	1 18	41 5	0 13	26 51	1 8	20
11	14 58	1 17	38 49	0 8	22 44	1 8	16 50	1 16	41 18	0 10	25 43	1 10	19
12	16 15	1 16	38 57	0 5	21 36	1 9	18 6	1 15	41 28	0 7	24 33	1 11	18
13	17 31	1 14	39 2	0 1	20 27	1 11	19 21	1 14	41 35	0 4	23 22	1 13	17
14	18 45	1 13	39 3	0 2	19 16	1 13	20 35	1 13	41 39	0 2	22 9	1 15	16
15	19 58	1 11	39 1	0 5	18 3	1 14	21 48	1 11	41 41	0 1	20 54	1 16	15
16	21 9	1 9	38 56	0 7	16 49	1 15	22 59	1 10	41 40	0 5	19 38	1 18	14
17	22 18	1 7	38 49	0 10	15 34	1 16	24 9	1 8	41 35	0 8	18 20	1 19	13
18	23 25	1 6	38 39	0 13	14 18	1 17	25 17	1 6	41 27	0 11	17 1	1 21	12
19	24 31	1 4	38 26	0 15	13 1	1 19	26 23	1 5	41 16	0 14	15 40	1 22	11
20	25 35	1 2	38 11	0 18	11 42	1 20	27 28	1 3	41 2	0 17	14 18	1 23	10
21	26 37	1 0	37 53	0 21	10 22	1 20	28 31	1 1	40 54	0 20	12 55	1 24	9
22	27 37	0 58	37 32	0 24	9 2	1 21	29 32	0 59	40 25	0 22	11 31	1 24	8
23	28 35	0 56	37 8	0 27	7 41	1 21	30 31	0 57	40 3	0 25	10 7	1 25	7
24	29 31	0 54	36 41	0 31	6 20	1 22	31 23	0 54	39 38	0 28	8 42	1 26	6
25	30 25	0 51	36 10	0 33	4 58	1 22	32 22	0 52	39 10	0 31	7 16	1 26	5
26	31 16	0 49	35 37	0 35	3 30	1 23	33 14	0 50	38 39	0 34	5 50	1 27	4
27	32 5	0 46	35 2	0 38	2 13	1 23	34 4	0 48	38 5	0 36	4 23	1 27	3
28	32 51	0 44	34 24	0 40	0 50	1 23	34 52	0 46	37 29	0 39	2 56	1 28	2
29	33 35	0 42	33 44	0 42	0 33	1 24	35 38	0 43	36 50	0 42	1 28	1 28	1
30	34 17		33 2		1 57		36 21		36 8		0 0		0
☽ eq. à ☉.	—	Dif.	—	Dif.	∓	Dif.	+	Dif.	+	Dif.	+	Dif.	☽ eq. à ☉.
	Sig. 11.		Sig. 10.		Sig. 9.		Sig. 8.		Sig. 7.		Sig. 6.		

Of Mr. MAYER's LUNAR EQUATIONS *and* MOTIONS.

" *ning the Sun's Altitude was almost* 56°. *at the End* 26°." Another Eclipse is mentioned in the same Place, but it being of the Moon, is therefore omitted. *Schickard*, who preserved them from Oblivion, adds the following REMARK; " *These three Observations were made by* " Ibn-Junis, *who by Order of* Abu-Haly-Almansor, *a wise Man, at that Time* King *of* Egypt, *devoted himself to the Study of Astronomy. The* " *Author's Tables are in the Hands of* James Golius, *Professor at* Lyons, *who communicated these Things to me out of them; in which there are* " *several other Observations both of his own and the preceding Age; the Place of Observation was near* Grand Cairo." After this Account was transcribed, ready for the Press, Mr. *Mayer* met with the same Account of these Eclipses, in the *Philosophical Transactions*, N°. 492, given by the celebrated *R. Dunlorne*, where they are applied to determine the *Acceleration* of the Moon's Motion; yet he was loth to envy his Readers the Passage he has quoted, as the Observations cannot be too well known among the Astronomers. *The Time of the former Eclipse, reduced to* Julian *Years, is* December 13, *Ann. Dom.* 977. *The* Beginning, *according to the Altitudes taken, is found to be* 8h. 24m. 24s. *the End* 10h. 43m. 44s. *Morning; supposing the Latitude of* Grand Cairo 30°. 2′. 30″. *as the Observations of the Moderns make it to be.* The other *Eclipse*, according to our Way of reckoning, happened *in the Year of* Christ 978, June 8: *the* Beginning, *from the observed Altitude of the Sun*, 2h. 30m. 16s. *the* End 4h. 50m. 24s. *Afternoon*: With these Times, particularly those of the Ends, Mr. *Mayer*'s *Lunar Tables* are said to agree within one or two Minutes, as any one (he says) will find by Trial. Whereas all the Tables before published by other Authors make the *Times of these Eclipses sooner by almost half an Hour*; an infallible Proof, that the Moon's Motion is now swifter than it was many Ages ago; and that the *Quantity* of *this Acceleration* has been rightly ascertained in the Equation Tables, according to Mr. *Mayer*, exhibited at the Beginning.

Nor, indeed, (he says) is this Acceleration of the ☽'s Motion so small, but that it may be plainly shewn from the Observations of this and the last Age only. He has found the Moon's mean Motion in 60 of our Years (besides 802 Revolutions) to be 1s 10° 43′ 24″ which yet other Tables (the Authors whereof having collected the Mean Motions from the earliest Observations only compared with the Modern) make to be 1s. 10°. 41′. 10″. or at most 1s. 10°. 42′. 15″. Now, we have a great many Observations of *Eclipses* made above 60 Years ago, and with Care and Diligence as at this Day. Most of these Mr. *Mayer* has reduced to Numbers, and asserts that he has not found one, that proves his Tables, constructed upon the Moon's *accelerated Motion*, to err a Minute in Longitude; whereas the Error would sometimes have been equal to 3 Minutes, had he retained the Quantity, he says, commonly assumed for the Moon's Mean Motion. He has also pursued, as he asserts, a particular Method to determine, most accurately, the Quantity of this Motion, notwithstanding the *Imperfection* of his Tables, should there be any yet in them. He chose such Eclipses, as were distant, in Time, one *Chaldean Period*, that is, 223 *Lunations*, or, which is better, several *Periods* Distance from each other, and as all the *Irregularities* of the Moon are in a Manner restored again after such an Interval of Time, the same Errors in his Tables must needs return again, *nearly*. If therefore it be known how much his Tables differ from Observations, at the End of one Period, We shall also know how much they ought to disagree at the Expiration of two or more such Periods; and if the Errors are found to be *unequal*, it is a Sign that the Mean Motion ought to be corrected by such a Quantity as will reduce them to an Equality

SUPPLEMENTAL

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr MAYER.

XIV. Reduction - Equation to the Ecliptic.

☽ à ☊	Arg. ☽ in Orb. à ☊ cor. 0 . 6 —	1 . 7 —	2 . 8 —	☽ à ☊
°	′ ″	′ ″	′ ″	°
0	0 0	6 2	6 2	30
1	0 14	6 9	5 55	29
2	0 29	6 15	5 47	28
3	0 43	6 21	5 39	27
4	0 58	6 27	5 30	26
5	1 12	6 32	5 20	25
6	1 26	6 37	5 10	24
7	1 41	6 41	5 0	23
8	1 55	6 45	4 50	22
9	2 9	6 48	4 39	21
10	2 23	6 51	4 28	20
11	2 37	6 54	4 17	19
12	2 50	6 56	4 5	18
13	3 3	6 57	3 53	17
14	3 16	6 57	3 41	16
15	3 29	6 57	3 29	15
16	3 41	6 57	3 16	14
17	3 53	6 57	3 3	13
18	4 5	6 56	2 50	12
19	4 17	6 54	2 37	11
20	4 28	6 51	2 23	10
21	4 39	6 48	2 9	9
22	4 50	6 45	1 55	8
23	5 0	6 41	1 41	7
24	5 10	6 37	1 26	6
25	5 20	6 32	1 12	5
26	5 30	6 27	0 58	4
27	5 39	6 21	0 43	3
28	5 47	6 15	0 29	2
29	5 55	6 9	0 14	1
30	6 2	6 2	0 0	0
☽ à ☊	+ 11 . 5	+ 10 . 4	+ 9 . 3	☽ à ☊

I. For the Latitude of the Moon.

Argument. ☽ in Orb. à Long ☊ corrected.

Arg. proper	0 . N. / 6 . S.	Dif.	1 . N. / 7 . S.	Dif.	2 . N. / 8 . S.	Dif.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″
0	0 0 0		2 34 25		4 27 38	
1	0 5 23	5 23	2 39 4	+ 39	4 30 18	2 40
2	0 10 46	5 23	2 43 39	+ 35	4 32 53	2 35
3	0 16 9	5 23	2 48 12	4 33	4 35 22	2 29
4	0 21 32	5 23	2 52 42	4 30	4 37 47	2 25
5	0 26 54	5 22	2 57 9	4 27	4 40 7	2 20
6	0 32 16	5 22	3 1 33	4 24	4 42 21	2 14
7	0 37 37	5 21	3 5 53	4 20	4 44 30	2 9
8	0 42 58	5 21	3 10 10	4 17	4 46 34	2 4
9	0 48 18	5 20	3 14 23	4 13	4 48 33	1 59
10	0 53 37	5 19	3 18 33	4 10	4 50 27	1 54
11	0 58 55	5 18	3 22 39	4 6	4 52 15	1 48
12	1 4 11	5 16	3 26 42	4 3	4 53 58	1 43
13	1 9 27	5 16	3 30 41	3 59	4 55 36	1 38
14	1 14 42	5 15	3 34 36	3 55	4 57 8	1 32
15	1 19 55	5 13	3 38 27	3 51	4 58 35	1 27
16	1 25 6	5 11	3 42 14	3 47	4 59 56	1 21
17	1 30 16	5 10	3 45 57	3 43	5 1 12	1 16
18	1 35 24	5 8	3 49 36	3 39	5 2 22	1 10
19	1 40 31	5 7	3 53 11	3 35	5 3 26	1 4
20	1 45 36	5 5	3 56 41	3 30	5 4 25	0 59
21	1 50 39	5 3	4 0 7	3 26	5 5 19	0 54
22	1 55 40	5 1	4 3 29	3 22	5 6 7	0 48
23	2 0 39	4 59	4 6 47	3 18	5 6 50	0 43
24	2 5 36	4 57	4 9 59	3 12	5 7 26	0 36
25	2 10 30	4 54	4 13 7	3 8	5 7 57	0 31
26	2 15 22	4 52	4 16 11	3 4	5 8 23	0 26
27	2 20 12	4 50	4 19 10	2 59	5 8 43	0 20
28	2 24 59	4 47	4 22 4	2 54	5 8 57	0 14
29	2 29 43	4 44	4 24 53	2 49	5 9 5	0 8
30	2 34 25	4 42	4 27 38	2 45	5 9 8	0 3
Ar. pr.	11 . S. / 5 . N.	Dif.	10 . S. / 4 . N.	Dif.	9 . S. / 3 . N.	Dif.

II. For the Latitude of the Moon.

Arg. 2 ☽ à ☉ — forgoing Arg. Lat. 0 . N. / 6 . S.	1 . N. / 7 . S.	2 . N. / 8 . S.	Arg. prop
′ ″	′ ″	′ ″	°
0 0	4 25	7 39	30
0 9	4 33	7 43	29
0 19	4 41	7 48	28
0 28	4 49	7 52	27
0 37	4 56	7 56	26
0 46	5 4	8 0	25
0 55	5 11	8 4	24
1 5	5 19	8 7	23
1 14	5 26	8 11	22
1 23	5 34	8 14	21
1 32	5 41	8 18	20
1 41	5 48	8 21	19
1 50	5 55	8 24	18
1 59	6 2	8 27	17
1 8	6 9	8 30	16
2 17	6 15	8 32	15
2 26	6 22	8 34	14
2 35	6 28	8 36	13
2 44	6 34	8 38	12
2 52	6 40	8 40	11
3 1	6 46	8 42	10
3 10	6 52	8 43	9
3 18	6 57	8 45	8
3 27	7 3	8 46	7
3 35	7 8	8 47	6
3 44	7 14	8 48	5
3 52	7 19	8 48	4
4 1	7 24	8 49	3
4 9	7 29	8 49	2
4 17	7 34	8 50	1
4 25	7 39	8 50	0
11 . S. / 5 . N.	10 . S. / 4 . N.	9 . S. / 3 . N.	Arg. prop

Of Mr. MAYER's LUNAR EQUATIONS *and* SOLAR NUMBERS.

Equality. In this Manner he has examined, he says, not one or two *Cycles* only, but a great many thereof; so that he further asserts there are very few *Eclipses*, of which Observations have been made in this and the last Age, but what have undergone this Examination.

With *these Tables* he has also compared many Observations of the Moon that were made a little earlier, by *Tycho*, *Walther*, *Regiomontanus*, as well in the *Syzygies* as without them, and have all along found as near an Agreement as could well be expected from Observations not made to the greatest Nicety and Exactness.

With Respect to His SOLAR NUMBERS, of the MEAN PLACES and MOTIONS, deducible from our own Examples, and which we have exhibited, with their Equation, (p. 59.) though he had not so much left for him to do as those going before him, yet he assumed no Principle, he says, but what has stood the Test of repeated Observations. Thus he retained the Motion of the Sun's *Apogeon*, exhibited in the Tables of Dr. *Flamsteed*, as agreeing nearest with Observations, especially those of *Hipparchus* and *Albategnius*. Moreover, he made the Quantity of the *Solar Tropical Year* invariable, agreeable to the Observations of *Hipparchus*, *Albategnius*, *Walther*, and, in short, of all the Astronomers of any Credit and Authority, except *Ptolemy*, whose *Equinoxes*, 'tis almost indisputably certain, were not ascertained by Observations of the Heavens; but determined by his own Tables, and the Quantity of the *Solar Year*, which he had received from *Hipparchus*. Mr. *Mayer* is therefore firmly of Opinion, from very substantial Reasons, that the *Chronological* Order of Time from *Ptolemy* down to us, has not been interrupted by the Omission of a Day or two. Lastly, Mr. *Mayer* has deduced the mean apparent Motion of the *Fixed Stars*, or the *Precession* o the Equinoxes, chiefly from *Timocharis*'s Observations of the Moon's *Appulses* to the *Fixed Stars*, which Method seemed to him more certain than if he had taken the Longitude of those Stars from *Hipparchus*, and made use of them to this purpose.

Who therefore thinks he has strictly examined and closely considered every Thing, that may be justly required of any one who takes the Subject in Hand, and has left nothing untried, he thinks, that might conduce to the perfecting of the *Moon's Theory*; a Point far the most intricate of all in the celestial Science. And, *if he is not greatly deceived*, his Tables are now brought to almost as great a Degree of Perfection, as the *Lunar Observations* themselves can be brought by the Methods hitherto made use of by the Astronomers; who further alledges, that

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. MAYER.

EQUATORIAL PARALLAX, and APPARENT DIAMETER of the MOON.

MEAN HORIZONTAL PARALLAX of the MOON, for the Middle State of her ORBIT, in, or out of, *Syzygies*.

Argument 11. Or ☽'s Corrected M. ANOMALY.

☽ Cor An.	Sig. 0. HorPar +		Sig. 1. HorPar +		Sig. 2. HorPar +		Sig. 3. HorPar +		Sig. 4. HorPar +		Sig. 5. HorPar +		☽ Cor An.
°	′	″	′	″	′	″	′	″	′	″	′	″	°
0	54	10	54	30	55	29	56	58	58	37	59	56	30
1	54	10	54	32	55	32	57	1	58	40	59	58	29
2	54	10	54	33	55	34	57	5	58	43	60	0	28
3	54	10	54	35	55	37	57	8	58	46	60	2	27
4	54	11	54	36	55	39	57	12	58	49	60	4	26
5	54	11	54	38	55	42	57	15	58	52	60	5	25
6	54	11	54	39	55	45	57	19	58	5[illegible]	60	7	24
7	54	11	54	41	55	47	57	22	58	58	60	8	23
8	54	11	54	42	55	50	57	25	59	1	60	10	22
9	54	12	54	44	55	53	57	29	59	4	60	11	21
10	54	12	54	46	55	56	57	32	59	7	60	13	20
11	54	12	54	48	55	59	57	35	59	10	60	14	19
12	54	13	54	49	56	2	57	38	59	13	60	15	18
13	54	13	54	51	56	5	57	42	59	16	60	16	17
14	54	14	54	53	56	8	57	45	59	18	60	17	16
15	54	15	54	55	56	11	57	48	59	21	60	18	15
16	54	15	54	57	56	14	57	51	59	23	60	18	14
17	54	16	54	59	56	17	57	55	59	26	60	19	13
18	54	17	55	1	56	20	57	58	59	29	60	20	12
19	54	18	55	3	56	23	58	1	59	31	60	21	11
20	54	19	55	5	56	26	58	4	59	34	60	22	10
21	54	20	55	7	56	29	58	8	59	36	60	22	9
22	54	21	55	9	56	32	58	11	59	39	60	23	8
23	54	22	55	12	56	36	58	14	59	41	60	24	7
24	54	23	55	14	56	39	58	18	59	44	60	25	6
25	54	24	55	17	56	42	58	21	59	46	60	25	5
26	54	25	55	19	56	45	58	24	59	48	60	26	4
27	54	26	55	22	56	49	58	28	59	50	60	26	3
28	54	28	55	24	56	52	58	31	59	52	60	26	2
29	54	29	55	27	56	55	58	34	59	54	60	26	1
30	54	30	55	29	56	58	58	37	59	56	60	26	0
☽ Cor An.	+ HorPar Sig. 11.		+ HorPar Sig. 10.		+ HorPar Sig. 9.		+ HorPar Sig. 8.		+ HorPar Sig. 7.		+ HorPar Sig. 6.		☽ Cor An.

1. Equat. Parx. for tr. State ☽ Orb. in or out of Syzygies.

Ar. 2. ☽ à ☉ — ☽ cor. An. or Arg. 12.

Arg. prop.	0 — 6 +	1 — 7 +	2 — 8 +
°	″	″	″
0	38	33	19
1	38	32	18
2	38	32	18
3	38	32	17
4	38	31	17
5	38	31	16
6	38	31	16
7	37	30	15
8	37	30	14
9	37	30	14
10	37	29	13
11	37	29	13
12	37	28	12
13	37	2[illegible]	11
14	36	28	11
15	30	27	10
16	36	2[illegible]	9
17	36	26	9
18	36	26	8
19	35	25	7
20	35	25	6
21	35	24	6
22	35	24	5
23	34	23	4
24	34	23	4
25	34	2[illegible]	3
26	34	21	3
27	33	21	2
28	33	20	1
29	33	2[illegible]	1
30	33	19	0
Arg. prop.	— 11 + 5	— 10 + 4	— 9 + 3

2. Equation of the ☽'s Parallax out of Syzigies, only.

Arg. ☽ eq. à ☉ true.

0 +	1 ±	2 —	3 —	4 ±	5 +	Arg. pro.
″	″	″	″	″	″	°
25	12	14	27	13	14	30
25	12	14	27	12	14	29
25	11	15	27	12	15	28
25	10	16	27	11	16	27
25	9	16	27	10	17	26
25	8	17	27	9	18	25
25	8	18	27	8	18	24
24	7	18	26	7	19	23
24	6	19	26	0	20	22
24	5	20	26	5	20	21
24	4	21	25	4	21	20
24	3	21	25	3	22	19
23	2	22	24	2	22	18
23	1	23	24	1	23	17
23	0	23	23	0	23	1[illegible]
23	1	24	23	1	24	15
22	1	24	22	2	24	14
22	2	25	22	3	25	13
21	3	25	21	4	25	12
20	4	25	21	5	25	11
19	5	26	20	6	26	10
19	6	26	19	7	26	9
18	7	20	19	7	26	8
17	8	26	18	8	26	7
17	9	26	17	9	27	[illegible]
16	10	27	16	10	27	5
15	10	27	16	11	27	4
15	11	27	15	11	28	3
14	12	27	14	12	28	2
13	13	27	13	13	28	1
12	14	27	13	14	28	0
+ 11	± 10	— 9	— 8	± 7	+ 6	Arg. pro.

For Diameter ☽ from Equatorial Parallax

Par. ′	″	Diam. ′	″
54	5	29	20
54	16	29	36
54	27	29	42
54	38	29	48
55	49	29	54
55	0	30	0
55	11	30	6
55	22	30	12
55	33	30	18
55	44	30	24
55	55	30	30
56	6	30	30
56	17	30	42
56	28	30	48
56	39	30	54
56	50	31	0
57	1	31	6
57	12	31	12
57	23	31	18
57	34	31	24
57	45	31	30
57	56	31	36
58	7	31	42
58	18	31	48
58	29	31	54
58	40	32	0
58	51	32	6
59	2	32	12
59	13	32	18
59	24	32	24
59	35	32	30
59	46	32	36
59	57	32	42
60	8	32	48
60	19	32	54
60	30	33	0
60	41	33	6
60	52	33	12
61	3	33	18
61	14	33	24
61	25	33	30

Of Mr. MAYER's LUNAR EQUATIONS, *and* SOLAR *and* LUNAR MOTIONS.

all who have been accustomed to the handling of Instruments, and making Observations therewith, must readily allow, how liable a Person is to err a *single Minute*. That unless the Astronomers should hereafter discover a Method of ascertaining the Moon's Place in the Heavens by Observations to a greater Degree of Exactness, he thinks a more perfect Theory of the Moon than that by his Tables, can hardly be expected or required. See *Cassini de Thury in Memoirs de l'Acad. Roy. des Sciences, et Belles Lettres de Berlin, Année* 1749. p. 364.

According to *his Tables* the mean *tropical solar* Year contains $365^d. 5^h. 48^m. 51^s. 12^{th}.$ and is, for ought appears from Observations, invariably the same; though perhaps the Quantity of the mean natural Days, or the Earth's diurnal Revolution, be not, according to the Opinion commonly received, equable.

Moreover, the mean *Periodical Lunar* Month he makes to be variable, and gradually, though slowly, diminishes: Its Decrease in a Century being 1^{th}. 5iv. 15v. At the Beginning of the *Century* 1700, the Periodical Month, was $27^d. 7^h. 43^m. 4^s. 45^{th}.$ 1iv. and at the Time, between *Hipparchus* and *Ptolemy*, or at the Beginning of the Christian *Æra*, it was $27^d. 7^h. 43^m. 5^s. 3^{th}. 30^{iv}.$ Hence the mean *Synodical* Month is continually decreasing. In the Beginning of the present *Century* 1700, its Quantity was $29^d. 12^h. 44^m. 2^s. 53^{th}. 23^{iv}.$ and at the Commencement of the *Christian Æra* $29^d. 12^h. 44^m. 3^s. 15^{th}.$ so that it loses in every hundred Years, *if Observations can be relied on*, 1^{th}, 16iv, 16v.

IN ECLIPSES OF THE MOON, the Semidiameter of the Earth's Shadow, found from the common Tables, must, on Account of the Earth's Atmosphere, be augmented by the *60th Part* of itself, or so *many Seconds* added to the said Semidiameter as there are *Minutes* contained in it.

Vide Commentarii Societatis Regiæ Scientiarum Gottingensis. Tomus II. ad Annum 1752. *Being The Acts of the* Gottingen *Society*.

Thus have we given an impartial Account of the *celebrated* Mr. *Mayer's Lunar* and *Solar Tables* in general, in order that they may be *judged* and compared with our own; *whatever Corrections, or Improvements of his Tables Mr.* Mayer *shall think fit to make hereafter*.

SUPPLEMENTAL SOLAR AND LUNAR EQUATIONS.

According to the original Construction of Mr. EULER, and late Improvement and Correction of his Plan.

Acceleration of the Sun's mean Motion.

Yrs. from 1700	Correction. + ° ' "	Dif. ' "
20	0 0 1	
40	0 0 2	0 1
60	0 0 4	0 2
80	0 0 6	0 2
100	0 0 10	0 4
150	0 0 22	0 12
200	0 0 40	0 18
250	0 1 2	0 22
300	0 1 30	0 28
350	0 2 2	0 32
400	0 2 40	0 38
450	0 3 22	0 42
500	0 4 10	0 48
550	0 5 2	0 52
600	0 6 0	0 58
650	0 7 2	1 2
700	0 8 10	1 8
750	0 9 22	1 12
800	0 10 40	1 18
850	0 12 2	1 22
900	0 13 30	1 28
950	0 15 2	1 32
1000	0 16 40	1 38
1100	0 20 10	3 30
1200	0 24 0	3 50
1300	0 28 10	4 10
1400	0 32 40	4 30
1500	0 37 30	5 50
1600	0 42 40	5 10
1700	0 48 10	5 30
1800	0 54 0	5 50
1900	1 0 10	6 10
2000	1 6 40	6 30
2500	1 44 10	37 30
3000	2 30 0	45 50
3400	3 12 40	42 40
4400	5 22 40	2°10'0"
&c.		

EQUATION of the *mean* to the *excentric* Anomaly of the SUN and MOON.

Argument. Mean Anomaly of the SUN and MOON, respectively.

☉ & ☽ M. An. °	Sig. 0. Eq. ☉ An. — ' "	Sig. 0. Eq. ☽ An. — ° ' "	Sig. 1. Eq. ☉ An. — ' "	Sig. 1. Eq. ☽ An. — ° ' "	Sig. 2. Eq. ☉ An. — ' "	Sig. 2. Eq. ☽ An. — ° ' "	Sig. 3. Eq. ☉ An. — ' "	Sig. 3. Eq. ☽ An. — ° ' "	Sig. 4. Eq. ☉ An. — ' "	Sig. 4. Eq. ☽ An. — ° ' "	Sig. 5. Eq. ☉ An. — ' "	Sig. 5. Eq. ☽ An. — ° ' "	☉ & ☽ M. An. °
0	0 0	0 0 0	28 24	1 27 56	49 29	2 35 13	57 37	3 4 5	50 20	2 44 1	29 14	1 36 46	30
1	0 59	0 3 3	29 15	1 30 37	49 59	2 36 53	57 37	3 4 14	49 50	2 42 28	28 21	1 33 53	29
2	1 59	0 6 6	30 6	1 33 16	50 29	2 38 31	57 37	3 4 20	49 19	2 40 53	27 28	1 30 58	28
3	2 58	0 9 9	30 57	1 35 55	50 57	2 40 4	57 36	3 4 22	48 47	2 39 4	26 34	1 28 1	27
4	3 57	0 12 11	31 47	1 38 32	51 25	2 41 37	57 33	3 4 21	48 14	2 37 33	25 39	1 25 2	26
5	4 56	0 15 14	32 36	1 41 8	51 51	2 43 6	57 29	3 4 17	17 40	2 35 49	24 44	1 22 1	25
6	5 55	0 18 16	33 25	1 43 41	52 17	2 44 32	57 24	3 4 9	47 5	2 34 0	23 48	1 18 57	24
7	6 54	0 21 18	34 13	1 46 13	52 42	2 45 55	57 18	3 3 58	46 30	2 32 9	22 52	1 15 53	23
8	7 53	0 24 19	35 1	1 48 43	53 6	2 47 17	57 11	3 3 43	45 53	2 30 15	21 56	1 12 47	22
9	8 52	0 27 21	35 48	1 51 11	53 28	2 48 34	57 3	3 3 25	45 16	2 28 18	20 59	1 9 39	21
10	9 50	0 30 22	36 34	1 53 37	53 50	2 49 49	56 55	3 3 3	44 38	2 26 8	20 2	1 6 30	20
11	10 49	0 33 22	37 20	1 56 3	54 11	2 51 1	56 45	3 2 38	43 59	2 24 14	19 4	1 3 19	19
12	11 47	0 36 22	38 5	1 58 26	54 31	2 52 10	56 33	3 2 10	43 18	2 22 8	18 6	1 0 7	18
13	12 45	0 39 21	38 49	2 0 47	54 50	2 53 16	56 21	3 1 38	42 37	2 20 0	17 7	0 56 54	17
14	13 43	0 42 19	39 33	2 3 6	55 8	2 54 20	56 6	3 1 3	41 56	2 17 48	16 9	0 53 39	16
15	14 40	0 45 17	40 16	2 5 22	55 25	2 55 20	55 54	3 0 25	41 13	2 15 33	15 10	0 50 23	15
16	15 38	0 48 13	40 58	2 7 37	55 31	2 56 17	55 39	2 59 43	40 30	2 13 16	14 11	0 47 7	14
17	16 35	0 51 10	41 39	2 9 50	55 56	2 57 10	55 23	2 58 57	39 46	2 10 56	13 11	0 43 49	13
18	17 32	0 54 7	42 20	2 12 1	56 10	2 58 2	55 5	2 58 8	39 2	2 8 33	12 11	0 40 31	12
19	18 28	0 57 2	43 0	2 14 10	56 23	2 58 52	55 47	2 57 17	38 17	2 6 7	11 11	0 37 12	11
20	19 25	0 59 56	43 40	2 16 17	56 35	2 59 35	54 27	2 56 21	37 31	2 3 39	10 10	0 33 52	10
21	20 20	1 2 49	44 19	2 18 21	56 46	3 0 17	54 7	2 55 22	36 44	2 1 9	9 10	0 30 31	9
22	21 16	1 5 42	44 57	2 20 23	55 56	3 0 56	53 46	2 54 19	35 57	1 58 36	8 9	0 27 8	8
23	22 11	1 8 33	45 34	2 22 22	57 5	3 1 30	53 24	2 53 14	35 9	1 56 0	7 8	0 23 46	7
24	23 5	1 11 22	46 10	2 24 19	57 12	3 2 2	53 0	2 52 5	34 20	1 53 23	6 7	0 20 23	6
25	23 59	1 14 12	46 45	2 26 15	57 19	3 2 32	52 36	2 50 53	33 30	1 50 42	5 6	0 17 0	5
26	24 53	1 16 59	47 20	2 28 7	57 25	3 2 57	52 10	2 49 36	32 40	1 47 59	4 5	0 13 36	4
27	25 46	1 19 45	47 53	2 29 57	57 30	3 3 18	51 44	2 48 18	31 49	1 45 15	3 4	0 10 12	3
28	26 39	1 22 31	48 26	2 31 46	57 33	3 3 37	51 17	2 46 56	30 58	1 42 27	2 2	0 6 48	2
29	27 31	1 25 14	48 58	2 33 31	57 35	3 3 53	50 49	2 45 30	30 6	1 39 38	1 1	0 3 24	1
30	28 24	1 27 56	49 29	2 35 13	57 37	3 4 5	50 20	2 44 1	29 14	1 36 46	0 0	0 0 0	0
☉ & ☽ M. An.	+ Eq. ☉ An.	+ Eq. ☽ An.	+ Eq. ☉ An.	+ Eq. ☽ An.	+ Eq. ☉ An.	+ Eq. ☽ An.	+ Eq. ☉ An.	+ Eq. ☽ An.	+ Eq. ☉ An.	+ Eq. ☽ An.	+ Eq. ☉ An.	+ Eq. ☽ An.	☉ & ☽ M. An.
	Sig. 11.		Sig. 10.		Sig. 9.		Sig. 8.		Sig. 7.		Sig. 6.		

Lunar EQUATION of the SUN, according to Mr. Euler.

Argument. MOON from the SUN.

☽ à ☉ °	Sig. 0. Lon. ☉. + "	Sig. 0. Sun à ⊖. + Parts	Sig. 1. Lon. ☉. + "	Sig. 1. Sun à ⊖. + Parts	Sig. 2. Lon. Sun. + "	Sig. 2. Sun à ⊖. + Parts	Sig. 3. Lon. Sun. + "	Sig. 3. Sun à ⊖. — Parts	Sig. 4. Lon. Sun. + "	Sig. 4. Sun à ⊖ — Parts	Sig. 5. Lon. Sun. + "	Sig. 5. Sun à ⊖. — Parts	☽ à ☉ °
0	0	7	7	6	13	3	15	0	13	3	7	6	30
5	1	7	8	5	14	2	15	0	12	3	6	6	25
10	2	7	9	5	14	2	15	1	11	4	5	6	20
15	3	7	10	4	15	1	15	1	10	4	3	7	15
20	5	6	11	4	15	1	14	2	9	5	2	7	10
25	6	6	12	3	15	0	14	2	8	5	1	7	5
30	7	6	13	3	15	0	13	3	7	6	0	7	0
☽ à ☉	— Lon. ☉.	+ Sun à ⊖.	— Lon. ☉.	+ Sun à ⊖.	— Lon. Sun.	+ Sun à ⊖.	— Lon. Sun.	— Sun à ⊖.	— Lon. Sun.	— Sun à ⊖.	— Lon. Sun.	— Sun à ⊖.	☽ à ☉
	Sig. 11.		Sig. 10.		Sig. 9.		Sig. 8.		Sig. 7.		Sig. 6.		

N. B. The Seconds under Sun's Long. are to be connected with his computed Long.; and Parts under Sun à ⊖ to be connected with the Dift. à ⊖, had from the Arg. Sun's M. Anom. in *Tab.* p. 60. *The above T. like* Mayer's.

REMARKS on the Sun and Moon's Mean Motions, according to Mr. *Leonard Euler*, of the *Royal Academy* of *Sciences* at *Berlin*, and F. R. S. at *London*.

First, *Of the* Sun's *mean* Motion *and* Acceleration.

"BY comparing *(our Author says)* the Obfervations of the feveral Ages, as delivered down to us, it appears that the apparent Motion of the *Sun*, caufed by the real one of the *Earth* in her Orbit, is *fwifter* than formerly, and that by a regular Acceleration, *(the fame as the celebrated* Tobias Mayer, *of* Gottingen, *has fince remarked of the Moon's mean Motion)* as by which Acceleration the mean *tropical* Year (or rather of that betwixt the *vernal Equinoxes)* has gradually decreafed to the prefent Time. From whence it is obfervable, (*fays our Author*) that the Diminution of the Quantity of the folar Year has been nearly *one Second of Time*, in each Century. Hence we may obferve, that the mean Motion of the Sun, *additive* to the limited mean Motion, (together additive to the limited mean Places) determining the correct mean Places for any Period or Year before or fince the *fixed Period of* 1700, from whence the *limited mean Places and Motions are determined*, muft increafe from the faid *Period* towards *Antiquity*, and likewife increafe from thence, in the fame Order towards *Futurity*; that the Sun's correct mean Places may every where regularly increafe at equal Diftances of Periods or Time forward. — This is a Point of correct Judgment fhewn by Mr. *Mayer* in the Acceleration of the Moon's mean Motion, or Increafe of her mean Places at equal Intervals

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Improvement and Correction of the celebrated Mr. EULER's Plan.

EULER's I. Equation of Mean Longitude for the *middle State* of the Moon's Orbit, . *Maximum* 6° 12′ 2″

Mayer's *Maximum* 6 18 44

Difference, Euler's *Maximum* too little . . . 6 42

Hence, *Mayer*'s XI. Equation *divided by* 56,53, *and the Quotient subtracted from that* Equation *will give* Euler's I. Equation, *if you chuse to try it.*

N. B. You may perform the Division by Logistical Logarithms; as shall be shewn further on.

☞ For EULER's I. use MAYER's XI. Equation.

EULER's II. Equation (Argument, Sun's *excentric* Anomaly) *Maximum* . . 9′ 44″

MAYER's Equation Moon's mean Anomaly, p. 97. (Argument, Sun's mean Anomaly) *Maximum* . . 10 18

Difference, Euler's *Maximum* too little . . 0 34

Hence, MAYER's Equation of Moon's *Anom.* (p. 97) *divided by* 18,18 *and the Quotient taken from that* Equation *will give* Euler's II. Equation.

☞ For EULER's II. use MAYER's Equation Moon's Anom. for Longitude (p. 97) with Arg. Sun's *excentric Anom.* of EULER, or Sun's mean Anomaly. Or, use our I. Equation (Arg. Sun's An.) p. 61.

	1st Part.	2d Part.
EULER's III. Equation (Arg. Moon twice equated à Sun) . . *Maxima* . .	33′ 27″	36′ 10″
MAYER's XIII. (Argument, Moon equated à Sun) . . *Maxima* . .	39 3	41 41
Difference, EULER's *Maxima* too little . .	5 36	5 31

Hence, Mayer's *first Part* XIII. Equation *divided by* 6,97, *and the Quotient taken from that* Equation *will give* Euler's III. Equation.

Also, Mayer's latter *Part* XIII. Equation *divided by* 7,55, *and the Quotient taken from that* Equation *will give* Euler's III. Equation.

☞ For EULER's III. use MAYER's XIII. Equation.

Intervals of Time forward, in Imitation of that same Correctness of Judgment shewn by Mr. *Euler* before him, in respect of the Sun or Earth's *Acceleration*, or Increases of Place at equal Intervals of Time. And therefore the further we go into *Antiquity* or *Futurity*, the greater will be the Correction of mean Motion or Place, from the stated Period whence the Correction begins; as at equal Distance of Time from that Period into *Antiquity* and *Futurity*, the Correction of the limited mean Motion will be evidently the same, according to the Hypothesis of an Acceleration of Motion, or Increase of mean Places at equal Intervals of Time forward.

N. B. Mr. *Euler*'s limited mean Motion of the Sun in 20 *Julian* Years, $= 20^r\ 0^s\ 0^\circ\ 9'\ 12'' = 20^r,0004259259$, *&c.* by which dividing 7305 Days in the 20 *Julian* Years, the Quotient will be $365^d\ 24222169$, *&c.* $= 365^d\ 5^h\ 48^m\ 47''\ 57'''$, *&c.* his limited mean Year; but according to his *Hypothesis* of Acceleration of the Sun's mean Motion, still diminishes from that Quantity.

Nobody, it is presumed, (says our Author) will deny the Earth's Situation is varied, a small Matter, by the Moon's *Attraction*, and therefore knowing the *Cause* to which this Variation may be ascribed, the *celebrated Euler* has, in a Table, shewn how much the *Sun's Place*, and his Distance from the Earth may be changed with Regard to each *lunar Aspect*.

He is, nevertheless, doubtful whether his *Corrections*, which he has taken from the *horizontal Parallax* 12½, will not be something *too little*; because, by comparing his several Corrections with former Observations, he has discovered that the Sun's *horizontal Parallax* is but 10″, or probably does not exceed it above ½ a *Second*. He therefore chuses to abide by his *Correction* of the Sun's limited *mean Motion* and Acceleration according to the *Hypothesis* he has laid down, till the Quantity of *Variation can be more accurately discovered from future Observation.*

He collected the Place of the Sun's Apogee, and the Excentricity of the Orbit from the Observations of the celebrated *Monnierus*, which he with great Study and Pains had instituted for the same Purpose, and published before that *remarkable Correction* from the Moon's Rising. He has made the *Motion of the Apogee* in Nothing different from the *Precession of the Equinox*, because (he says) the Arguments used by Astronomers to prove the *particular Motion of the Apogee* forward of the fixed Stars, appear (*to him*) to be insufficient. For though he allows the *Resistance* of the *Ether*, diminishing the Earth's Orbit, from whence the Acceleration of the Earth's Motion, or *Decrease* of the Year, is supposed to proceed, yet he has found, from this *Resistance*, the Position of the *Line of Apsides* of the Sun, or Earth in her Orbit, not to be affected therewith; whence, he would rather (*if any Variation of the Apogee, with Regard to the fixed Stars can be truly demonstrated*) attribute it to the Action of a *Comet* sometimes passing very near the *Earth*.

Of the Lunar Numbers *and* Equations *of Mr.* EULER.

The Design of which (*he says*) to set forth at large would take up too much Room in the Compass of his *small Essay*: He therefore observes, that they are taken from the same *Theory of Attraction* which the celebrated Sir Isaac Newton introduced into the Science of Astronomy with so happy Success. That though there are several *lunar Tables*, published before his, founded on the same *Hypothesis*, yet he asserts that the Calculation to which the *Principle of Attraction* is relative, is exceedingly intricate, and that all those *Tables* widely differ from the *Theory*; nor does he pretend to have shewn all the *unequal Motions* in these *Tables*. Nevertheless, he has set forth *all the Equations* (he says) perceptible to Observation, and which are to be found after the first *half Minute*.

Thus far he offers his Calculation to the Public; shewing the Title and *Argument* of every *individual* Inequality or *Equation*, determining most of the *certain Quantities* of each, according to the aforesaid *celebrated Theory*. Some of which Quantities and Equations he was obliged to ascertain by Observation; others (he says) depend upon the *Sun's Distance from the Earth*, or his *horizontal Parallax*, which, agreeable to the latest Observations, he finds to be 12″½; but, afterwards, on comparing these several *lunar Equations* with former *Observations*, he finds the *Sun's Parallax* cannot probably be reckoned above 10″.

He farther observes, that whoever compares his *Tables* with others already published, may presently discern a vast Difference both in the *Titles and Arguments of the Equations*. That as he makes Use of the *eccentrical Anomalies* of the Sun and Moon, he places them by themselves, in both *solar* and *lunar Tables*, that those and the other *Anomalies* may be the more readily found.

That, though the Number of his Equations is larger than in any other *Tables* preceding his, yet he has so contrived them, that the Computation may be made much sooner, and with less Trouble from them than by former Tables.

And lastly, that, since all *Causes* affecting the *Moon's Place* and her Distance from the *Earth*, are *so very variable*, he has added the *more Tables*, by the Help of which, (he says) the Distance of the Moon from the Earth, and from thence her *horizontal Parallax* and *apparent Diameter* may be the more correctly and readily known.

See *Latin Preface to the* Berlin astronomical Tables, *from which Tables Mr.* Mayer *probably derived many of his later Improvements, particularly the Acceleration of the Moon's mean Motion, by an Eye had to Mr.* Euler's *Acceleration first supposed of the Sun's mean Motion, and Solution of the Moon's central* Equation, *afterwards imitated by Mr.* Mayer, (who likewise solved the Moon's Parallax for the true State of her Orbit in like Manner) *as he partly acknowledges, whence his Improvements, by confessing that the same celebrated* Eulerus (Author of the abovementioned Tables) *was the first who solved the Moon's* Central Equation, *in two Parts, without* Eccentricity, (see p. 99 of our Work) and "so adorned "the lunar Theory with a neat, and elegant Contraction." *And who admits* (see Remarks at the Bottom of Mr. *Mayer*'s Equation Tables) *that the above-mentioned Mr.* Euler *was the first who reduced the* Newtonian Theory *to general analytical* Equations, *which Mr.* Mayer *afterwards* "*hit upon an elegant and concise Method of resolving.*"

SUPPLEMENTAL

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. EULER.

IV. EQUATION of the MOON, or EVECTION.

Argument. Twice Dist. MOON from SUN — Excentric Anom. MOON.

Arg. pro.	Sig. 0. —	Dif.	Sig. 1. —	Dif.	Sig. 2. —	Dif.	Sig. 3. —	Dif.	Sig. 4. —	Dif.	Sig. 5. —	Dif.	Arg. pro.
°	° ' "	' "	° ' "	' "	° ' "	' "	° ' "	' "	° ' "	' "	° ' "	' "	°
0	0 0 0		0 36 59		1 4 5		1 14 0		1 4 5		0 36 59		30
1	0 1 18	1 18	0 38 5	1 6	1 4 43	0 38	1 13 59	0 1	1 3 26	0 39	0 35 53	1 6	29
2	0 2 34	1 16	0 39 12	1 7	1 5 20	0 37	1 13 57	0 2	1 2 45	0 41	0 34 45	1 8	28
3	0 3 52	1 18	0 40 18	1 6	1 5 55	0 35	1 13 53	0 4	1 2 4	0 41	0 33 36	1 9	27
4	0 5 9	1 17	0 41 23	1 5	1 6 31	0 36	1 13 49	0 4	1 1 20	0 44	0 32 26	1 10	26
5	0 6 27	1 18	0 42 27	1 4	1 7 3	0 32	1 13 43	0 6	1 0 36	0 44	0 31 16	1 10	25
6	0 7 44	1 17	0 43 30	1 3	1 7 36	0 33	1 13 35	0 8	0 59 51	0 45	0 30 6	1 10	24
7	0 9 1	1 17	0 44 32	1 2	1 8 6	0 30	1 13 26	0 9	0 59 5	0 46	0 28 55	1 11	23
8	0 10 18	1 17	0 45 34	1 2	1 8 36	0 30	1 13 16	0 10	0 58 18	0 47	0 27 43	1 12	22
9	0 11 35	1 17	0 46 34	1 0	1 9 4	0 28	1 13 5	0 11	0 57 30	0 48	0 26 31	1 12	21
10	0 12 51	1 16	0 47 34	1 0	1 9 32	0 28	1 12 52	0 13	0 56 41	0 49	0 25 18	1 13	20
11	0 14 8	1 17	0 48 33	0 59	1 9 57	0 25	1 12 38	0 14	0 55 50	0 51	0 24 5	1 13	19
12	0 15 23	1 15	0 49 31	0 58	1 10 22	0 25	1 12 22	0 16	0 54 58	0 52	0 22 51	1 14	18
13	0 16 39	1 16	0 50 27	0 56	1 10 46	0 24	1 12 5	0 17	0 54 7	0 51	0 21 37	1 14	17
14	0 17 54	1 15	0 51 24	0 57	1 11 7	0 21	1 11 48	0 17	0 53 14	0 53	0 20 24	1 13	16
15	0 19 9	1 15	0 52 19	0 55	1 11 28	0 21	1 11 28	0 20	0 52 19	0 55	0 19 9	1 15	15
16	0 20 24	1 15	0 53 14	0 55	1 11 48	0 20	1 11 7	0 21	0 51 24	0 55	0 17 54	1 15	14
17	0 21 37	1 13	0 54 7	0 53	1 12 5	0 17	1 10 46	0 21	0 50 27	0 57	0 16 39	1 15	13
18	0 22 51	1 14	0 54 58	0 51	1 12 22	0 17	1 10 22	0 24	0 49 31	0 56	0 15 23	1 16	12
19	0 24 5	1 14	0 55 50	0 52	1 12 38	0 16	1 9 57	0 25	0 48 33	0 58	0 14 8	1 15	11
20	0 25 18	1 13	0 56 41	0 51	1 12 52	0 14	1 9 32	0 25	0 47 34	0 59	0 12 51	1 17	10
21	0 26 31	1 13	0 57 30	0 49	1 13 5	0 13	1 9 4	0 28	0 46 34	1 0	0 11 35	1 16	9
22	0 27 43	1 12	0 58 18	0 48	1 13 16	0 11	1 8 36	0 28	0 45 34	1 0	0 10 18	1 17	8
23	0 28 55	1 12	0 59 5	0 47	1 13 26	0 10	1 8 6	0 30	0 44 32	1 2	0 9 1	1 17	7
24	0 30 6	1 11	0 59 51	0 46	1 13 35	0 9	1 7 36	0 30	0 43 30	1 2	0 7 44	1 17	6
25	0 31 16	1 10	1 0 36	0 45	1 13 43	0 8	1 7 3	0 33	0 42 27	1 3	0 6 27	1 17	5
26	0 32 26	1 10	1 1 20	0 44	1 13 49	0 6	1 6 31	0 32	0 41 23	1 4	0 5 9	1 18	4
27	0 33 36	1 11	1 2 4	0 44	1 13 53	0 4	1 5 55	0 36	0 40 18	1 5	0 3 52	1 17	3
28	0 34 45	1 9	1 2 45	0 41	1 13 57	0 4	1 5 20	0 35	0 39 12	1 6	0 2 34	1 18	2
29	0 35 53	1 8	1 3 26	0 41	1 13 59	0 2	1 4 43	0 37	0 38 5	1 7	0 1 18	1 16	1
30	0 36 59	1 6	1 4 5	0 39	1 14 0	0 1	1 4 5	0 38	0 36 59	1 6	0 0 0	1 18	0
Arg. pro.	+ Sig. 11.	Dif.	+ Sig. 10.	Dif.	+ Sig. 9.	Dif.	+ Sig. 8.	Dif.	+ Sig. 7.	Dif.	+ Sig. 6.	Dif.	Arg. pro.

MAYER's Argument to the above EVECTION-EQUATION is twice the Moon from Sun — Mean Anom. Moon.

The above *Maximum* . . . 1° 14′ 0″

MAYER's *Maximum* of Evection or XII. Equation . . . 1 20 43

Difference, EULER's *Maximum* too little . . . 6 43

Hence, MAYER's Evection-Equation *divided by* 12,02, *and the Quotient taken from that* Equation, *will give the above* Equation *of* EULER, *correspondent*.

☞ *For the above* Equation *use* MAYER's XII. Equation, *if you neglect the following* V. Equation *of* EULER. But, if you *retain* the Vth. with the *above* EVECTION of EULER, they will, *conjunctly* used, come near MAYER's EVECTION or XII. EQUATION; and *compensate* for some Errors, or *Inequalities*, of the *Lunar* Orbit.

N. B. The *Evection-Equation* according to STREET's intricate Method of computing it (from the *Chord Evection*, and Argument of half the *Synodical* Anomaly) is supplied by the easier Computation of the *Evection-Equation* above. Which Equation is applied to the *central* Equation for the mean Eccentricity, and is therefore equal to about half of STREET's *Evection*, applied to the central (or correspondent *eccentric*) Equation, for the *least* Eccentricity of the *Lunar* Orbit.

SUPPLEMENTAL LUNAR EQUATIONS.

According to the Construction of Mr. EULER.

V. EQUATION of the MOON.

Arg. Twice ☽ à ☉ — Twice Exc. Anom. ☽

Arg. pro.	Sig. 0.	Sig. 1.	Sig. 2.	Sig. 3.	Sig. 4.	Sig. 5.	Arg. pro.
	+	+	+	+	+	+	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	4 12	7 16	8 24	7 10	4 12	30
1	0 9	4 20	7 21	8 24	7 12	4 4	29
2	0 18	4 27	7 25	8 24	7 7	3 57	28
3	0 26	4 34	7 29	8 23	7 3	3 49	27
4	0 35	4 42	7 33	8 23	6 58	3 41	26
5	0 44	4 49	7 37	8 22	6 53	3 33	25
6	0 53	4 56	7 40	8 21	6 48	3 25	24
7	1 1	5 3	7 44	8 20	6 43	3 17	23
8	1 10	5 10	7 47	8 19	6 37	3 9	22
9	1 19	5 17	7 51	8 18	6 32	3 1	21
10	1 28	5 24	7 54	8 16	6 26	2 52	20
11	1 36	5 31	7 57	8 15	6 20	2 44	19
12	1 45	5 37	7 59	8 13	6 15	2 36	18
13	1 53	5 44	8 2	8 11	6 9	2 27	17
14	2 2	5 50	8 4	8 9	6 3	2 19	16
15	2 10	5 56	8 7	8 7	5 56	2 10	15
16	2 19	6 3	8 9	8 4	5 50	2 2	14
17	2 27	6 9	8 11	8 2	5 44	1 53	13
18	2 36	6 15	8 13	7 59	5 37	1 45	12
19	2 44	6 20	8 15	7 57	5 31	1 36	11
20	2 52	6 26	8 16	7 54	5 24	1 28	10
21	3 1	6 32	8 18	7 51	5 17	1 19	9
22	3 9	6 37	8 19	7 47	5 10	1 10	8
23	3 17	6 43	8 20	7 44	5 3	1 1	7
24	3 25	6 48	8 21	7 40	4 56	0 53	6
25	3 33	6 53	8 22	7 37	4 49	0 44	5
26	3 41	6 58	8 23	7 33	4 42	0 35	4
27	3 49	7 3	8 23	7 29	4 34	0 26	3
28	3 57	7 7	8 24	7 25	4 27	0 18	2
29	4 4	7 12	8 24	7 21	4 20	0 9	1
30	4 12	7 16	8 24	7 16	4 12	0 0	0
Arg.	—	—	—	—	—	—	Arg.
pro.	S. 11.	S. 10.	Sig. 9.	Sig. 8	Sig. 7.	Sig. 6.	pro.

VI. EQUATION of the MOON.

Arg. Twice ☽ à ☉ + Excen. Anom. ☽.

Arg. pro.	Sig. 0.	Sig. 1.	Sig. 2.	Sig. 3.	Sig. 4.	Sig. 5.	Arg. pro.
	+	+	+	+	+	+	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	0 26	0 44	0 52	0 44	0 26	30
5	0 5	0 30	0 46	0 52	0 42	0 22	25
10	0 9	0 33	0 48	0 51	0 39	0 17	20
15	0 13	0 36	0 50	0 50	0 36	0 13	15
20	0 17	0 39	0 51	0 48	0 33	0 9	10
25	0 22	0 42	0 52	0 46	0 30	0 5	5
30	0 26	0 44	0 52	0 44	0 26	0 0	0
Arg.	—	—	—	—	—	—	Arg.
pro.	S. 11.	S. 10.	Sig. 9.	Sig. 8.	Sig. 7.	Sig. 6.	pro.

VII. EQUATION of the MOON.

Arg. Twice ☽ à ☉ — Excent. Anom. ☉.

Arg. pro.	Sig. 0.	Sig. 1.	Sig. 2.	Sig. 3.	Sig. 4.	Sig. 5.	Arg. pro.
	—	—	—	—	—	—	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	0 29	0 49	0 57	0 49	0 29	30
5	0 5	0 33	0 52	0 57	0 47	0 24	25
10	0 10	0 37	0 54	0 56	0 44	0 19	20
15	0 15	0 40	0 56	0 56	0 40	0 15	15
20	0 19	0 44	0 56	0 54	0 37	0 10	10
25	0 24	0 47	0 57	0 52	0 33	0 5	5
30	0 29	0 49	0 57	0 49	0 29	0 0	0
Arg.	+	+	+	+	+	+	Arg.
pro.	S. 11.	S. 10.	Sig. 9.	Sig. 8.	Sig. 7.	Sig. 6.	pro.

VIII. EQUATION of the MOON.

Arg. Twice ☽ à ☉ + Excentric Anom. ☉.

Arg. pro.	Sig. 0.	Sig. 1.	Sig. 2.	Sig. 3.	Sig. 4.	Sig. 5.	Arg. pro.
	—	—	—	—	—	—	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	0 0	0 21	0 36	0 42	0 36	0 21	30
5	0 4	0 24	0 38	0 42	0 34	0 18	25
10	0 7	0 27	0 40	0 41	0 32	0 14	20
15	0 11	0 30	0 41	0 41	0 30	0 11	15
20	0 14	0 32	0 41	0 40	0 27	0 7	10
25	0 18	0 34	0 42	0 38	0 24	0 4	5
30	0 21	0 36	0 42	0 36	0 21	0 0	0
Arg.	+	+	+	+	+	+	Arg.
pro.	S. 11.	S. 10.	Sig. 9.	Sig. 8.	Sig. 7.	Sig. 6.	pro.

SIMILAR to VI. above, of *Euler*, is *Mayer's* VI. Equation, his *Maximum* being 1′ 30″ instead of 52″; and similar to VII, above, of *Euler*, is *Mayer*'s III. Eq. whose *Max.* is 1′ 2″ instead of 57″; and sim. to *Euler*'s VIII. above, is *Mayer*'s II, whose *Max.* is 54″ instead of 42″, according to *Euler*: allowing for the Dif. between the mean Anomalies of *Mayer*, and excentric Anomalies of ☉ and ☽ of *Euler*, in the respective Arguments, the Signs of both these Authors Equations agreeing. But Mr. *Mayer* has not any Equat. *similar* to Mr. *Eulers* V. Equat. above, which Equat. is the only Exception of Difference from all Authors before him that we have seen. The Moon's Place in her Orbit is nearly obtained by the VIII. *foregoing* EQUATIONS, partly from Mr. MAYER, and partly from Mr. EULER's *Plan*. After which *Orbit Place* of the Moon is had, MAYER's XIV. or *Reduction-Equation* from the Orbit to the Ecliptic may be applied, or any of our own *Reduction-equations*, for that Purpose. And the *Parallax* and apparent Semi-Diameter of the Moon to be afterwards determined according to our Tables for *that Purpose*, at the Beginning of this Work, or else by Mr. MAYER's *Supplemental Equation-Tables*, for the same Purpose, and not by the *Halleian* Method; because EULER considers no *second* EQUATION *of the Moon's Apogee* for determining the Argument of *true Anomaly of the Moon*, on which the *Parallax*, and consequently apparent Semi-Diameter of the Moon, chiefly depends, according to the *Halleian Computation*.

Mr. EULER has given five Equations of the ascending Node, following the foregoing VIII. of the Moon's Orbit, and with the 3d Equation of the Moon's ☊ has given the Inclination of her Orbit, which he corrects by two following Equations, with those of the ☊. And with the 5th Equation of the Node, he has given a *Reduction* of the Orbit-Place of the Moon to that of the Ecliptic, at a *mean Quantity*, which Equation he makes the same as the 5th Equation of the Node.

He then determines the Distance of the Moon from the Earth, by the following *Arguments* to VIII. Equations: 1. *Mean Anom.* ☽; 2. *Excentric An. Sun*; 3. *Moon twice equated from Sun*; 4. *Twice Moon à Sun — excentric An. Moon*; 5. *Twice Moon à Sun — twice excent. An.* ☽; 6. *Twice* ☽ *à Sun + excentric An.* ☽; 7. *Twice* ☽ *à Sun — excen. An. Sun*; 8. *Twice* ☽ *à Sun + excen. An. Sun.* He corrects the first Distance by the several following Equations of Distances, according to their proper Signs, and having obtained the correct Distance (according to this Method) he takes out the horizontal *Parallax*, and apparent *Diameter* of the Moon, according to the Argument of that correct Distance.

N. B. He makes the Moon's horizontal Parallax to the apparent Diameter as 60′ 40″ to 33′ 20″. — But these Methods are not so certain and correct as others we have exhibited; yet we would not omit to oblige our Readers with Mr. EULER's Ingenious Discoveries.

DIFFERENT

DIFFERENT METHODS OF SOLVING THE Keplerian PROBLEM.

A LIMITED CORRECTION *of* WARD's Hypothesis, *by two Terms in Seconds, to be connected with the mean Anomaly, for determining the true Angle, at the* upper Focus *of a* Planet, *from* Aphelion.

PUT $a =$ Sem. Transf. Orbit, $b =$ Sem. Conjugate, $c =$ Eccentricity, and describing a Circle, on the upper *Focus*, whose Radius $= 1$, $z =$ Arch next Aphel. to where a Line intersects it drawn from the upper *Focus* to the Planet; Sine of that Arch $= y$, Cos. $= x$. Whence, by Property of an Ellipsis, the Length of the intersecting Line, or Distance from the *upper Focus* to the Planet $= \frac{a^2 - c^2}{a + cx} = \frac{bb}{a + cx}$ (because $bb = aa - cc$) and the Planet's Distance from the Sun $= \frac{aa + cc + 2acx}{a + cx}$; and $\frac{1}{2} bb\dot{z} + \frac{\frac{1}{2} b^2 c^2 y^2 \dot{z}}{\overline{a + cz}|^2} =$ Fluxion of the Area described by the Planet from *Aphelion*, by Rays drawn to the Sun, in the lower *Focus*.

Resolve $\frac{1}{\overline{a + cx}|^2}$ into $\frac{1}{a^2} - \frac{2cx}{a^2}$, &c. for a *Nearness*. Whence the Fluxion above becomes $\frac{1}{2} b^2 \dot{z} + \frac{\frac{1}{2} b^2 c^2 y^2 \dot{z}}{a^2} - \frac{b^2 c^3 x y^2 \dot{z}}{a^3}$, which, because $y\dot{z} = -\dot{x}$, and $x\dot{z} = \dot{y}$, reduces to $\frac{1}{2} b^2 \dot{z} + \frac{b^2 c^2}{2aa} \times -\dot{x}y - \frac{b^2 c^3 y^2 \dot{y}}{a^3}$, whose *Fluent* is $\frac{1}{2} b^2 z + \frac{b^2 c^2}{2a^2} \times \overline{\frac{1}{2} z - \frac{1}{2} xy} - \frac{b^2 c^3 y^3}{3a^3}$ (the *Area* of the circular Segment next Aphelion, formed by the Curve z, its Sine y, and $1 - x$, its versed Sine from the Vertex next Aphelion, being $= \frac{1}{2} z - \frac{1}{2} xy$) which Fluent when z Arch $=$ Semi-Circle $= p$, and y, its Sine, $= 0$, becomes $\frac{b^2 p}{2} + \frac{b^2 p}{2} \times \frac{c^2}{2a^2} = \frac{b^2 pd}{2}$ (supposing $d = 1 + \frac{c^2}{2a^2}$) the Area of the Semi-Orbit or Ellipsis from Aphelion. Whence, as $\frac{b^2 pd}{2}$ Area Semi-Ellipsis : $\frac{b^2 dz}{2} - \frac{b^2 c^2 xy}{4aa} - \frac{b^2 c^3 y^3}{3a^3}$ Area *elliptic Sector* from Aphelion :: p Length of an Arch of 180° : $z - \frac{c^2 xy}{2a^2 d} - \frac{2c^3 y^3}{3a^3 d} =$ the Length of the correspondent Arch of Mean Anomaly $=$ A. From which Equation, $z = \mathrm{A} + \frac{c^2 xy}{2a^2 d} + \frac{2c^3 y^3}{3a^3 d} = \mathrm{A} + \frac{c^2}{4a^2 d} \times \mathrm{Sin.}\ 2z + \frac{2c^3}{3a^3 d} \times \overline{\mathrm{Sin.}\ z}|^3$ (because xy, or Cos. $z \times$ Sin. $z = \frac{1}{2}$ S. $2z$). Here, for *another Nearness*

Different METHODS of solving the KEPLERIAN PROBLEM.

or Approximation, you may consider the *two last* Terms of the Equation, *viz.* $\frac{c^2}{4a^2d} \times \text{Sin. } 2z + \frac{2c^3}{3a^3d} \times \overline{\text{Sin. } z}|^3$ of small Value in Respect of the Arch A, and therefore make $z = A$, being *nearly so*. Whence, for Sine z and Sine $2z$, substituting Sine A and Sine 2A, and $z = A + \frac{cc}{4a^2d} \times \text{Sin. } 2A + \frac{2c^3}{3a^3d} \times \overline{\text{Sin. } A}|^3$, where z the Arch round the Upper *Focus*, or Angle from Aphelion, is now not to be considered equal to A, but to A + its *Correction*, by the Quantities $\frac{cc}{4a^2d} \times \text{Sin. } 2A + \frac{2c^3}{3a^3d} \times \overline{\text{Sin. } A}|^3$; which Quantities are reduced to *Seconds of a Degree*, by saying

As 3,4159 &c. (Length of an Arch of 180°, *Radius* being 1) is to 648000 *Seconds* in that Arch, so is $\frac{cc}{4a^2d} \times \text{Sin. } 2A + \frac{2c^3}{3a^3d} \times \overline{\text{Sin. } A}|^3$ (the Arch of Correction) to $51566 \times \frac{c^2}{a^2d} \times \text{Sin. } 2A + 137510 \times \frac{c^3}{a^3d} \times \overline{\text{Sin. } A}|^3$ = the *Number of Seconds* to be *added* to the given Mean Anomaly, for the *correct Angle of the Planet from* ~~*Aphelion*, at the Upper *Focus*; which Correction serves in the Planetary Orbits of *small Eccentricity, Saturn, Jupiter,*~~ the *Earth, Venus,* and the *Moon,* but not correctly in the Orbits of *Mars* and *Mercury,* while our *universal Rule,* Page 99, correctly serves for all Orbits whatsoever.

To determine the Value of the foregoing Correction of the Mean Anomaly (according to Ward's *Hypothesis) so that the ∠ at the Upper Focus of a Planet's Place, from Aphelion, may be truly known according to the above limited Correction?*

LOGARITHMICALLY, *from the foregoing Expressions.*

$$4.7123634 + 2 \text{ Log. } \frac{c}{a} - \text{Log. } d + \text{Log. Sine } 2A = \text{Log. 1st Term.}$$

$$5.1383343 + 3 \text{ Log. } \frac{c}{a} - \text{Log. } d + 3 \text{ Log. Sine } A = \text{Log. 2d Term.}$$

Here a, the Sem. Transf. being considered $= 1$, the Log. of $\frac{c}{a}$ = Log. c of Eccentricity, and $d = 1 + \frac{cc}{2aa} = 1 + \frac{cc}{2}$, and its Log. is *small,* and may be rejected or taken at a *mean Quantity,* for all the *Planetary* Orbits, except those of *Mars* and *Mercury.*

Suppose $c = ,06$, then $d = 1.0018$, whose Log. $= 0.0007810$.

Hence, $\overline{4.71148} + 2$ Log. c + Log. Sine 2A = Log. *1st Term in Seconds.*

$3 \times \overline{1.71252 + \text{Log. } c + \text{Log. Sine } A}$ = Log. *2d Term in Seconds.*

IN WORDS.

1. *To the Sum of the* constant *Log.* 4.71148, *and twice the Log. of Eccentricity in Parts of Unity, the Sem. Transverse, add the Log. Sine of twice the Mean Anomaly, and the Sum* (rejecting Radius) *will be the Logarithm of the* first Term in Seconds, *to be added to, or subtracted from, the Mean Anomaly, according as it is less or greater than* 90 *Degrees.*

2. *To the Sum of the* constant *Log.* 1.71252, *and the Log. of Eccentricity, add the Log. Sine of the Mean Anomaly, the Sum* (rejecting Radius) *being tripled, will be the Log. of the* second Term in Seconds, *to be always added to the Mean Anomaly.*

N. B. The Mean Anomaly is here always reckoned from and to Aphelion, wherein the *Seconds* may be omitted in computing the Corrections; which being made, Say, as the *Aphelion Dist. is to the Perih. Dist. so is the Tangent of half the corrected Mean Anomaly, or true Angle of the Planet at the Upper Focus, from Aphelion, to the Tangent of half the true Anomaly, or Angle, at the lower Focus of a Planet, from Aphelion, required.*

EXAMPLE I.

The Eccentricity of the Orbit of Jupiter, *being* 0,048219 *(according to* Dr. Halley) *and the Mean Anomaly of that Planet* 75°, *required the true Anomaly?*

1st Term.		2d Term.	
4.71148	Const. Log.	1.71252	Const. Log.
7.36643	twice Log. Eccy.	8.68322	Log. Eccentricity.
2.07791	Sum.	0.39574	Sum.
9.69897	Log. S. twice An.	9.98494	Log. Sine Anom.
1.77688 . .	59″,82+	0.38068	
		tripled 1,14294 . . .	13″,86+
			59,82 +
		Correction	73,68 +

Hence the ∠ of the Planet at the *Upper Focus* =

	75°	1′	13″	40‴	Log^s.
½	37	30	36	50 . . Tang. . .	9.8851410
				Const. Log. Orb.	9.9580851
	34	52	33	53	Tang. 9.8432261
Doubled	69	45	7	46	the *true* Anomaly.
	75	00	0	00	*Mean* Anomaly.
	5	14	52	54	*True* Equation, agreeing with Dr. *Halley's* Tables.

By

Different METHODS of ſolving the KEPLERIAN PROBLEM.

By *Bullialdus*'s Correction.

	Logs.
As Sem. Conj. = $\sqrt{1{,}048219 \times 0.951781}$ . .	0.0005554 co.
To Sem. Tranſ. = 1, . . .	0.0000000
So Tang. 75° Mean Anom.	10.5719475
To Tang. 75° 1′ 5″ 45‴ ∠ at Upper Focus	10.5725029
½ . . . 37 30 33 . . . Tang. . .	9.8851243
Conſt. Log. Orb.	9.9580851
34° 52′ 30″ . . . Tang. .	9.8432094

Doubled 69 45 0 The true Anom. *nearly.*
75 00 0 M. Anomaly.

5 15 0 Equation, *nearly.*
5 14 52 Above.

+ 8″ Error.
Here it is obſervable that *Bullialdus*'s is a *near* Correction.

EXAMPLE II.

Required the true Anom. from the Mean 120°, in the ſame Orbit?

1ſt Term.	2d Term.
4.71148 conſt. Log.	1.71252 conſt. Log.
7.36643 tw. Log. Ecy.	8.68322 Log. Eccy.
2.07791 co. L. for 1. T.	0.39574 conſt. Lo. for 2d Ter.
9.93753 Lo. S. 2 An. = [240°.	9.93755 Log. S. An. = 120°.
2.01544 L. 103″,62 −	0.33329
9,95 +	trip. 0.99937 Log. 9″,95 +

− 1′ 33″ 40‴ = 93,67 − Correction.
M.A. 120° 0 00 00

119 58 26 20 the correct ∠ at the *Upper Focus*, from Aphel.

	Logs.
half 59 59 13 10 . . Tangent . . .	10.2383328
Conſt. Log. Orb.	9.9580851
57 32 10 13 . . . Tangent . .	10.1964179

doubl. 115 4 20 26 The true Anom.
120 0 00 00 M. Anom.

4° 55′ 40″ The *correct Equation*, agreeing with Dr. *Halley*'s Tables.

By *Bullialdus*'s Correction.

	Log.
As Sem. Conjugate of the Orbit . . .	0.0005554 co.
To Sem. Tranſ. 1.	0.0000000
So Tangent M. Anom. 120° or T. 60°.	10.2385606
To Tang. 119° 58′ 6″ or 60° 1′ 54″ . ∠ at the Upper Focus, *nearly.*	10.2391160
Half . . 59° 59′ 3″ . . Tangent . . .	10.2382834
Conſt. Log. Orb. .	9.9580851
Doubled 57° 32′ 0″ . . . Tang.	10.1963685

115 4 0 True Anom. *nearly.*
120 0 0 M. Anom.

4 56 0 Equation nearly
4 55 40 Correct Equation from above.

+20″ Error, by *Bullialdus.*

EXAMPLE III.

Required the Correction of 140°. Mean Anomaly of the Moon's Orbit; the Eccentricity being greateſt, or 0,066777? Alſo to find the true Equation and Anomaly?

1. Term.	2. Term.
4.71148 Conſt. Log.	1.71252 Conſt. Log.
7.64925 twice Log. Eccentricity.	8.82463 Log. Eccy.
2.36073 Conſt. Log. for 1ſt Term	0.53715 Con. Lo. for 2d Ter.
9.99335 Log. S. 2. An. = 280° or 80°.	9.80806 Log. S. An. = 140°.
2.35408 Log. 226″ = 3′ 36″ −	0.34521
2 +	*tripled* 1.03563 Log. 2″ *fere* +

3′ 34″ − *Correction*, agreeing with *Halley*'s Tables, *pro expediendo calculo*, &c.
½ 1 47 *Halley.*
½ M. Anom. 70° 0′ 00″
1 47 Correction

	Log.
½ ∠ at *Upper Focus* 69 58 13 . Tangent .	10.4382336
Log. for Eq. ☽ Cent.	9.9419120
67° 22′ 37″ 25‴ Tangent	10.3801456

Doubled 134 45 14 50 True Anom. ☽ required.
140 00 00 00 Mean Anom. ☽.

− 5 14 45 10 Correct Equation ☽'s Center.

M. Eq. ☽ Center.
By p. 68. Argt. 4s 20° = 140° Anom. 4° 16′ 34″
For greateſt Eccentricity + 58 17 Gr. Dif. Eq. [above.
5 14 51 Eq. ☽ Center nearly as above.

By *Bullialdus*'s Correction.

	Logs.
As Sem. Conj. = $\sqrt{1.066777 \times {,}933223}$	0.0009705 co.
To Sem. Tranſverſe = 1, ...	0.0000000
So Tangent M. Anom. 140° or T. 40°	9.9238135
To Tang. 40° 3′ 47″ or 139° 56′ 13″ .	9.9247840
½ 69 58 6½ Tan.	10.4381875
Conſt. Log. for Orb.	9.9419120
67° 22′ 30″ Tan.	10.3800995

Doubled 134 45 0 The true Anomaly, nearly.
140 00 0 M. Anom.

− 5 15 0 Equation, *nearly.*
− 5 14 45 Equation fr. above correct.

+15″ Error, by *Bullialdus.*

EXAMPLE IV.

To find the Angle at the Upper Focus *at* 110° *M. Anomaly in the Orbit of* Mars, *whoſe Eccentricity, according to Dr.* Halley, *is* 0,09263936? *And likewiſe to determine the true Anomaly, and the Equation of the Orbit.*

By the Logarithmic Equations aforegoing,

1ſt Term.		2d Term.	
4.712363	Conſt. Log.	5.138334	Conſt. Log.
7.933591	2 Log. Eccy.	6.900387	3 Log. Eccy.
9.998139	co. Log. *d.*	9.998139	co. Log. *d.*
2.644093	Sum. *For the Orbit* ♂.	2.036860	Sum.
+ 9.808067	Log. S. 2 A = 220°.	9.911957	3 Log. S. A.
2.452160	Log. 283″,24 −	1.955817	Log. 90″,334
			1′ 30″,33

− 4′ 43″,24 1ſt Term.
+ 1 30, 33 2d Term.

3 12, 91 Correction.
110°. 0. 00, 00 M. Anom.

109 56 47, 09 ∠ at the Upper Focus.

Half

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	Logs.
Half 54 58 23,5 . Tangent	10.1543409
Const. Log. Orb.	9.9189890
49 48 $51\frac{1}{2}$. Tangent	10.0733299

Doubled 99 37 43 True Anomaly.
110 00 00 M. Anom.

Dif. —10 22 17 Equation Orbit.
By Dr. *Halley*'s Tab. —10 22 15 Equation ♂ for 3^s 20° M. An.

+2″ Error.

By *Bullialdus*'s Correction.

	Logs.
As Sem. Conj. $\sqrt{1.092639 \times ,907361}$.	0.0018716 co.
To Sem. Transf. 1.	0.0000000
So Tang. M. Anom. 110°, or 70° its Suppt.	10.4389341
To Tan. 109° 55′ 15″] or its Supt 70° 4′ 15″ [∠ at the Upper Focus, nearly.]	10.4408057

	Log.
Half 54° 57′ $37''\frac{1}{2}$ . . Tangent . .	10.1541348
Const. Log. Orb. .	9.9189890
49 48 3 . . Tangent . .	10.0731238

Doubled 99 36 6 True Anomaly, nearly.
110 00 0 M. Anom.

Dif. —10 23 54 Equation.
—10 22 15 Equation by Dr. *Halley*'s Tables.

+1 39 Error, by *Bullialdus*.

By RULE. P. 88.

	Logs.
As Rad.	10.0000000
To Cos. M. An. or S. 20°. . . .	9.5340517
So Eccy + its $\frac{1}{4}$ = ,1157992 . .	9.0637055
To ,0396057— 1.	8.5977572
As ,9603943	0.0175505 co.
To Double Eccy. . ,1852787 . .	9.2678254
So S. M. An. 110° or 70° . . .	9.9729858
To S. 10° 26′ $40''\frac{1}{2}$ . . .	9.2583617
	3
Log. S. Cube	7.7750851
Log. 3. . .	4771215—
— 6′ 49″ . Log. S. $\frac{1}{3}$ Cube.	7.2979636

Equation 10 19 $51\frac{1}{2}$
10 22 15 Dr. *Halley*.

—2 $23\frac{1}{2}$ *Error* by this Rule, greater than by *Bullialdus*'s Correction of *Ward*.

N. B. This *Rule* is chiefly of Use for the Orbits of the *Earth*, *Venus*, *Jupiter* and *Saturn*, and sometimes that of the *Moon*, but never to be depended on for the Orbits of *Mars* and *Mercury*. The Truth or Failure of this, or any other Rule for the same Purpose, may be proved by our *Universal and Correct Rule*, p. 99.

EXAMPLE V.

The Mean Anomaly of Mercury *being* 115°. (Eccentricity ,20589) *to determine the Angle at the* Upper Focus, *True Anomaly and Equation of the Orbit?*

1st Term.		2d Term.	
4.7123631	Const. Log.	5.1383541	Const. Log.
8.6272701	2 Log. Eccy.	7.9409061	3 Log. Eccy.
9.9908911	Co. Log. d.	9.9908911	Co. Log. d.
3.3305241	Sum. For Orb. ☿	3.0701311	Sum.
9.8842541	Log. S. 2 An.	9.8718271	3 Log. S. A.
3.214778	Log. 1639″,7—	2.941958	Log. 874″,9+
			14′ 34″,9

1. Term. 27′ 19″,7—
2. Term. 14 34 ,9+

12 44, 8 — limited Correction by 2 Terms.
115° 00 00

114 47 15,2 ∠ at the Upper *Focus*, nearly.

	Logs.
Half 57 23 37,6 . Tangent .	10.1940374
Const. Log. Orb. ☿	9.8185730
45° 49′ 54″,2 . Tangent .	10.0126104

Doubled 91 39 48,4 The True Anomaly.
115 00 00 . M. Anomaly.

Dif. —23 20 11,6 Equation by the *limited Correction*.
Ar. 3^s 25° or 115° —23 18 35 Equation in Dr. *Halley*'s Tables.

+1 36,6 Error of the *limited Correction*.

By *Bullialdus*'s Correction.

	Logs.
As Sem. Conj. $\sqrt{1.20589 \times ,79411}$.	0.0094058 co.
To Sem. Transv. 1.	0.0000000
So Tang. M. Anom. 115° or 65° .	10.3313275
To 114° 31′ 41″ ∠ at Upper Focus] 65° 28′ 19″ too great an Error.	10.3407333
For $\frac{1}{2}$ 57° 15′ 50″,5 . . Tangent .	10.1918731
Const. Log. Orb. ☿ .	9.8185730
45° 41′ 20″ . . . . Tan. .	10.0104461

doubl. 91 22 40 True Anom. . . . Error about 19′.
[in this Orbit, by *Bullialdus*.

N. B. The foregoing limited Correction *of* Ward's *Hypothesis by* two Terms *only, will give the Angle at the* Upper Focus *of a Planet, from Aphelion, correct, in the Orbits of the* Earth *and* Venus *(of small Eccentricity) by the Use of the first Term only: The* second Term *in Orbits of small Eccentricity, being but of small Value, in respect of the first Term, may be then safely rejected.*

Improvement being as much the Object of our Attention as Things of original Invention, the *limited Correction* of *Ward*'s Hypothesis, by two Terms, you will find has not always the Readiness of the RULE, *p.* 88: Similar to which, we hope to see *other* RULES *deduced*, for finding, directly and truly, the EQUATIONS for all Orbits whatsoever. An *Approximation* of this Sort will be less tedious and perplexing than a *Number of Terms* as follow, employed to find the true Angle at the *upper Focus*, which being done, (by much Labour and Attention) then there must be a further Operation to determine the *true Anomaly*, and consequently the EQUATION of the Orbit; which EQUATION would be best arrived at by the *direct Method* above proposed.

Putting

Different METHODS of solving the KEPLERIAN PROBLEM.

Putting $e=\frac{c}{a}$, $f=\frac{b}{a}$, S = Sine A, ſ = Sine following Quantity, and continuing the Terms of the former *Fluxion* of the *elliptic Sector*, by making $\frac{1}{a^2}-\frac{2cx}{a^3}+\frac{3c^2x^2}{a^4}-\frac{4c^3x^3}{a^5}$, *&c.* $=\frac{1}{\overline{a+cx}|^2}$, and considering the *Rectangle of the Cosines of any two Angles (Radius being Unity) to be equal to half the Sum of the Cosines of the Sum and Diff. of the Angles*, then, after a *prolix* Process,

$$\frac{180\times60\times60}{3.14159}\times\overline{\overline{1+4ee}\times\frac{2}{3}e^3fS^3-\frac{37e^5f}{15}S^5+\tfrac{1}{4}e^2f\mathrm{ſ}.2\,A+\frac{5e^4f^2}{32}\mathrm{ſ}.4\,A}.$$

will be the Number of *Seconds* to be added to the mean Anomaly, that the Angle at the *upper Focus*, (and thence the Angle at the lower one) may be more correctly found. Whence are derived the

Following Equations.

Let E *denote the Log. of Eccentricity divided by half the greater Axis,* F *the Log. of half the less Axis divided by half the greater,* G *the Log. of the Sum of the Squares of half the greater Axis and twice the Eccentricity divided by the Square of half the greater Axis.*

$$\left.\begin{array}{l}\text{Take } P=1{,}71277+E+\tfrac{1}{3}F+\tfrac{1}{3}G\\ Q=1{,}14130+E+\tfrac{1}{3}F\\ R=4{,}71236+2E+F\\ S=4{,}50824\end{array}\right\}\begin{array}{l}\text{Then the Log}^{s}\text{. of 4 Terms}\\ \text{in Seconds to be connected}\\ \text{with A, will be}\end{array}\left\{\begin{array}{l|l}1. & 3\times\overline{P+\text{Log. S. A}-\text{Log. Rad.}}\\ 2. & 5\times\overline{Q+\text{Log. S. A}-\text{Log. Rad.}}\\ 3. & R+\text{Log. S. }2A-\text{Log. Rad.}\\ 4. & S+\text{Log. S. }4A-\text{Log. Rad.}\end{array}\right.$$

Of which 4 Terms the first is always to be added, the Second always to be subtracted: The other two to be added or subtracted according as the Sines of the respective Arguments, 2 A *and* 4 A *are positive or negative.*

The two principal of the Terms (see p. 53. *of Misc. Tracts*) agree with those before exhibited, being like those two Terms or Equations laid down by Sir Isaac Newton in *Schol.* to 31. *Prop. Book* I. of his *Principia.* If a correcter and conciser Fluent of the Fluxion of an *elliptic Sector*, formed by Rays drawn from the Curve to the lower *Focus* can be obtained, a farther and more certain Correction of *Ward*'s Hypothesis will be of Advantage, which otherwise, in numerous unconverging Terms, will be intricate and useless.

As the foregoing Correction of *Ward*'s Hypothesis by *four Terms* is not perfectly exact in all Parts of the Orbit of *Mercury*, a farther Correction in this, and other more excentrical Orbits, is as follows.

RULE.

As *half greater Axis of the Ellipsis is to the Eccentricity, so is Sine of the mean Anomaly to the Sine of another Angle first found; subtract this first found Angle from the mean Anomaly, and to the Log. Sine of the Remainder* (which you may call the eccentric Anomaly) *add the Sum of the Log. of the Eccentricity and the constant Log.* 1.7581227 (the last being Log. of Degrees 57°,295779 = Rad.) *the Sum* (rejecting Radius) *will be the Log. of an Angle in Degrees and decimal Parts, which being subtracted from the first found Angle, the* Difference *will leave a Correction to be added to the mean Anomaly.*

With this corrected Anomaly, repeat the Operation (if necessary) *by always adding the last* Correction *to the given mean Anomaly.*

Then say, As the greater Sem. Axis of the Ellipsis is to the less, so is the Tangent of the corrected Anomaly, *to the Tangent of the Angle at the upper* Focus *of the Ellipsis; whence the Angle at the lower* Focus, *or true Anomaly, is had by the common Proportion.*

The foregoing Rule is true to a *Second* at one *Operation*, in all the Orbits of the Planets, except those of *Mars* and *Mercury*; in the former of the two last mentioned Orbits, the *greatest Error* is about *three* or *four Seconds*, and in the latter amounts to nearly as many *Minutes*, in which last Orbit *three repeated Operations* will be necessary for a true Correction. But, to avoid this Trouble, the following Method of *Computation*, (not quite so *prolix* as the former) is true to *half a Second*, even in the Orbit of *Mercury*, without repeating the prolix Operation!

A less Prolix Rule.

Add together the Log. Cos. of the Sum of the mean Anomaly once corrected, and the excentric Anomaly, the Log. Secant of the Angle first found (by the former Rule) and twice *the Log. of Eccentricity*, (in all of which Angles the Seconds may be neglected) *the* Sum *of all (deducting twice the Radius) will be the Log. of a* Fraction *to be added to Unity, when the* Sum *of the said Anomalies is between* 90° *and* 270°, *but otherwise to be* subtracted *therefrom.*

Then the Log. of this Sum, *or* Remainder, *being subtracted from the Log. of the first Correction in Minutes, you will have the Log. of the true Correction in Minutes, to be added to the given Mean Anomaly.*

Different METHODS of Solving the KEPLERIAN PROBLEM.

EXAMPLE.

The mean Anomaly being 70°, *in the Orbit of* Mercury, *whose Eccentricity has been assigned* =,20589, *to determine the true Anomaly, according to the* LAST METHOD?

	OPERATIONS.	Logs.
1.	L. Sine M. An. 70° . .	9.9729858
	Log. Eccentricity ,20589 .	9.3136353
	Log. 11° 9′ ,33 ∠ first found .	9.2866211
	70 00 ,00 M. An.	
2.	Diff. 58° 50′ ,67 Ecc. An: L. S. .	9.9323552
	Add Log. for the Orbit . . .	1.0717583
	Log. 10° 5′,71 = 10°,0952 . .	1.0041135
	∠ f. found 11 9 ,33	
	Dif. 1° 3′,62 Correction add to M. An.	
	+ 70 0 M. Anom.	
	+ 58 50 Excentr. Anom.	
	[Operation repeats. *Here the former* [*repeated.* [*Here the Operation continues, when not*	
3.	☞ † *Sum* 129 53, Cos. 39° 53′ . .	9.8070
	Add Log. Sec. ∠ f. found 11° 9′ . .	10.0083
	Add *twice* Log. Eccy	8.6272
	0.0272 ‡ Log.	8.4425
	+ 1.	
4.	Sum 1.0272 . . Log. . .	0.01187—
	Log. Mins first Correction 63′,62 . . .	1.80359
	Log. Mins true Correction 61′,9 . .	1.79172
5.	M. An. 70° + 51′,9 = 71° 1′,9 Log. Tan.	10.4638087
	Add Log. Conj. Axis	9.9905940
	∠ at *Upper Focus*, Log. Tan. 70° 38′,82 .	10.4544027
6.	Half . . . 35 19,41, L. Tan.	9.8504350
	Log. *Ratio* greatest and least Distances . .	9.8185730
	½ true An. 25° 1′,02 . . L. Tan. .	9.6690080
	Doubled 50 2,04 = 50° 2′ 2″, the *true Anom. required.*	

† Sum Ans.

‡ *Add to* / *sub. fr.* } 1. { *between* 90° *and* 270° / *otherwise.* }

*** *Compare the foregoing Method with our* universal *and* correct Method *at* p. 96. *directly solving the same.*

The Mean Anomaly of Mercury *being as before, to find the true Anomaly*, by RULE p. 88.

M. An. under. / above. } 90° { *M. An.* above. / under. } 270° { *4th Prop.* ‖add to / sub. fr. } 1.

	Logarithms.
As Rad.	10.0000000
To Cos. M. Anom. or S. 20° . .	9.5340517
So the Eccy. + its ¼ = ,2573625 .	9.4105452
To ,08802314‖ . . .	8.9445969
1. + the Sem. Transf.	
Now, As 1.08802314 . .	9.9633619 co.
To ,41178 Doubl. Eccy. .	9.6146652
So Sine M. Anom. 70° . .	9.9729858
To S. 20° 49′ 58″	9.5510129
	3
Log. S. Cube	8.6530387
Log. 3. .	4771215—
— 51′ 33″ Log. S. ⅓ Cube	8.1759172

Equation 19 58 25—
M. Anom. 70 00 00

Nearly True An. 50° 1′ 35″ by the *Practical Rule*, p. 88.
Correctly True An. 50 2 2 by universal and *correct* RULE, p. 96.

— 27″ Error of *Rule*, p. 88, in this Part of [the Orbit.

REMARK.

The celebrated Author of the late *Miscellaneous Tracts*, Mr. *T. Simpson*, in the first Page of his Preface, has denominated his *limited Correction* (not designed to solve the *Keplerian* Problem, universally, as it is done at p. 96. of this Work) "a *Correction of Ward's circular Hypothesis.*" But *Ward*'s Hypothesis has, by all others, been considered as *elliptical* (and not *circular*) requiring elliptical Correction. And yet, in another Place, at p. 48. of his *mathematical Essays*, the same celebrated Author has examined the Error of *Ward's Hypothesis* (five or six Minutes in the Orbit of *Mars*) and corrected it for the elliptical Defect of *Bullialdus*'s Hypothesis; which Hypothesis itself used to be a Correction of *Ward*'s.

He has next examined, (p. 49. same Essays) a different *circular* Hypothesis to the antient one, for *Bullialdus*'s Hypothesis: And, instead of there considering, as the Antients did, to answer their Purpose, the circular Hypothesis, as having *double* the elliptic Eccentricity, he has examined and attempted to correct the *circular Hypothesis*, so called of the Antients, by supposing it of *equal* Eccentricity with *Ward*'s late elliptical Hypothesis, which he has (as we before observed) denominated *the circular Hypothesis*.

From all which Novelties, and *Miscellaneous Discoveries*, in his late *Tracts*, aforesaid, *such as the Precession of the* Equinoxes, double the Quantity to what Sir ISAAC NEWTON found it, from Experience; *The Advantage arising, by Chance, from taking the* Mean *of a Number of Observations, &c. but,* above all, *his Deduction of all the* less *Lunar Equations, without the* Central, *from a mechanic* Principle, *and compounded analytical Equations, with a* VOLUME *promised, in* Futuro, *depending partly on Dr.* Bradley's *Observations) we may expect to see exhibited every Operation necessary to the forming of a* complete *Theory of the Moon's Motion,* (depending more on physical Hypotheses, than on Experience and Observation) *and so behold a New and glorious Light shining on* ASTRONOMY! *or else,* by *some* Mischance, *in using the Mean of a Number of Operations,* (*more laborious than difficult*) *we shall find the Subject involved in impenetrable Darkness!*

RULES and EXAMPLES

FOR DETERMINING

Other REQUISITES of ELLIPTICAL ORBITS.

PROPOSITION I.

To determine the Distance of a Planet, or Comet, from the SUN, *from the true Anomaly and Eccentricity of the Orbit given?*

EXAMPLE.

Mercury's *true Anomaly being* 66° 32′ 24″, *and Eccentricity of his Orbit* ,20589, *required his Distance from the* SUN?

RULE 1.	*Logarithms.*
As Square *Radius* (taking it 1) . . .	0.0000000
To Square Sine half true An. 33° 16′ 12″	9.4784880
So Dist. betn. *Foci*, or double Eccy. ,41178	9.6146652
To Fourth Proportional P = ,1239234	9.0931532
Then, As Sum Perih. Dist. +P,9180334 co.	0.0371415
To Perih. Dist. . . . ,794110 .	9,8998807
So Aphel. Dist. . . . 1.20589 .	0.0813077
To Dist. ☿ from ☉ . . 1.043109 .	0,0183299

RULE 2.	
As *Radius* (taking it 1).	0.0000000
To Cos. true An. 66° 32′ 24″ . .	9.6000017
So the Eccentricity, ,20589	9.3136353
To Fourth Propor1. Q = ,0819666 . .	8.9136370
Then, As half greater *Axis*—Q,9180334 co.	0.0371415
To Perih. Dist. ,794110 . . .	9.8998807
So Aphel. Dist. 1.20589 . . .	0.0813077
To Dist. ☿ from ☉ . 1.043109 . .	0.0183299

N. B. The *First Term* in the last Proportion is always half greater Axis ± Q.

Sigs. true Anoms.

For $\left\{\begin{matrix} 3.\ 4.\ 5.\ 6.\ 7.\ 8. \\ 0.\ 1.\ 2.\ 9.\ 10.\ 11. \end{matrix}\right\} \begin{matrix} + \\ - \end{matrix}$ Q + half greater Axis is the *First Term*.

PROPOSITION II.

To determine the Eccentric Anomaly of a Planet, or Comet, from the true Anomaly and Eccentricity given?

EXAMPLE.

Mercury's *true Anomaly is given* 66° 32′ 24″, *and Eccentricity of the Orbit* ,20589, *required the Eccentric Anomaly?*

RULE 3.	*Logarithms.*
As √ Perih. Dist. ,79411 . . co.	0.0500596
To √Aphel. Dist. 1.20589 . . .	0.0406538
So Tang. half true Anom. ☿ 33° 16′ 12″	9.8169886
To Tang. half eccentric An. ☿ 38° 57′ 25″	9.9077020

Doubled . 77 54 50 excentric Anomaly required.

PROPOSITION III.

To determine the Mean Anomaly and Equation correspondent of a Planet, or Comet, from the Excentric Anomaly and Eccentricity of the Orbit given?

EXAMPLE.

Excentric Anomaly of Mercury *is given* 77° 54′ 50″, *and Eccentricity of his Orbit* ,20589, *required his Mean Anomaly and Equation of his Orbit?*

	Logarithms.
Radius 57°,295779	1.7581227
Eccentricity ,205890	9.3136353
See p. 96. . . . *Const. Log.* for Orbit	1.0717580

RULES for finding the REQUISITES of ELLIPTICAL ORBITS.

RULE 4.

	Conft. Log. Orbit	1.0717580
Excentric Anom.	77° 54′ 50″ . Log. Sine	9.9902651+
Dif. bet. cor. Ex. & M. An.	+11 32 6 . 11°,53515	1.0620231
Sum, M. Anom.	89 26 56	[By Dr. *Halley*'s Tables,
True Anom. .	66 32 24—	[Eq^n. 22° 54′ 30″
Our Equation ☿	22 54 32 agreeing with Dr. *Halley*.	

PROPOSITION IV.

To determine the Diftance of a Planet, or Comet, from the SUN, *from the excentric Anomaly, true Anomaly, and Eccentricity of the Orbit given?*

EXAMPLE.

The true Anomaly of Mercury *being* 66° 32′ 24″, *Excentric Anomaly* 77° 54′ 50″, *and Eccentricity of the Orbit* ,20589, *required his Diftance from the* SUN?

RULE 5.

	Logarithms.
As Sine true An. 66° 32′ 24″ . . co.	0.0374705
To Sine Exc. An. 77 54 50 . .	0.9902651
So Sem. Conjugate = . . .	
$\sqrt{\text{Ap.Dift.} \times \text{Per.Dift.}} = \sqrt{1.20589 \times ,79411}$	9.9905943
To Dift. ☿ from ☉ . . 1.043109 .	0.0183299

The fame as before.

OTHERWISE. RULE 6.

As Sine half true Anom. 33° 16′ 12″ . co.	0.2607560
To Sine ½ Excent. An. 38 57 25 .	9.7984685
So $\sqrt{\text{Perih. Dift. },79411}$ . . .	9.9499404
To $\sqrt{\text{Dift. ☿ from ☉}}$ . . .	0.0091649
The Dift. ☿ from ☉ req^d. 1.043109 doubled	0.0183298

The fame as before.

N. B. *When the Diftances from the Sun are determined by the foregoing Rules in any of the planetary Orbits, a Table of Logarithms may be compofed to thefe Diftances, at Sight, from* Gardiner's *Tables, to fix Places of Figures.*

PROPOSITION V.

To determine the greateft Equation *of a* Planet, *or* Comet, *or greateft Difference between its mean and true Anomalies?*

EXAMPLE.

The Sem. Tranfverfe of Mercury's *Orbit being* 1, *and Eccentricity* ,20589, *required the greateft Equation?*

RULE 7.

From the lower Focus, as a Center with Radius, a *mean Proportional* between the *Sem. Tranfverfe* and *Sem. Conjugate* of the Orbit, defcribe an Arch to interfect the elliptical Curve, and the *Point* of that Interfection will be the Planet's *true Place*, at the Time of the *greateft Equation?*

Hence, $\sqrt{\text{Ap. Dift.} \times \text{Perih. Dift. } 1.20589 \times ,79411}$ $= ,9785754 =$ Semi Conjugate, $\sqrt{,9785754 \times 1} = ,98923$ a *mean Proportional* betwixt both *Axes*, being the *Diftance of Mercury from the Sun*, at the Time of his greateft Equation; Double Eccentricity = ,41178 Dift. *Foci*; and 1.01077, the Diftance from the Planet to the upper *Focus* (by the Nature of an *Ellipfis*, the two Diftances of a Planet from the upper and lower *Focus*, being always equal to the Tranfverfe Axis of its Orbit) whence, from thefe three Sides of a given Triangle, the Angle of *true Anomaly*, at the Sun, or lower *Focus*, is determined to be 81° 4′ 6″,8, as follows.

Sides △ in fame Ratios.				Sides △
98923 = ☉ ☿, from Sun to Mercury				,98923
41178 = ☉ F, from Sun to Upper Focus				,41178
101077 = ☿ F, from Mercury to Upper Focus				1.01077
half 241178 = Sum				Sum 2.41178
		Ind^s.	Ind^s.	
120589 = H = Half	co. Log.	4.9186923	9	1.20589
19512 = H — ☿ F (oppofite to ∠ required) . .	co. Log.	5.7096982	0	,19512
79411 = H — ☉ F	Log.	4.8998807	9	,79411
21666 = H — ☉ ☿	Log.	4.3357787	9	,21666
	Half	19.8640499	29 deduct Rad. fr. thefe Indices	
40° 32′ 3″,4 . .	Tang.	9.9320249		
Doubled 81 4 6,8 . .	The ∠ at ☉, oppofite ☿ F, being the ∠ of true Anomaly, *required.*			

*** *To determine an Angle oppofite to a given Side in any right-lined Triangle, whofe three Sides are given?*

RULES for finding the REQUISITES of ELLIPTICAL ORBITS.

RULE 8.

*** Add the three Sides together, and take ½ the Sum, and all the Differences betwixt that half Sum and each of the 3 Sides, according to the foregoing Order. Then set down under each other, the *arithmetical Complements of the Logarithms* of the *half Sum*, and of that *Difference* between the *half Sum* and the *Side* opposite to the Angle *sought*; then set down (under those co. Logs.) the *Logarithms* of the *Differences* betwixt the said half Sum and the other two Sides; the half Sum of which will be the Tangent of half the Angle required.

Now (by *Rule* 3.)	Logs.
As √Perih. Dist. ,79411 . . . . . co.	0.0500596
To √Aphel. Dist. 1,20589	0.0406538
So Tang. ½ true An. (just found) 40° 32′ 3″,4	9.9320249
To Tang. ½ excentric An. ☿ at the Time of greatest Equation . . . 46° 29′ 57″,2	10.0227383
Doubled . . . 92 59. 54,4 . the excent. [Anom. at the Time of the *greatest Equation*.	
(By *Rule* 4.) Const Log. for Orbit . . .	1.0717580
Cor. ex. An. 92° 59′ 54″,4 } Supplement 87 0 5 ,6 } . Log. Sine	9.9994050 +
Dif. bet. M. and excent.] An. . +11 46 49 ,7 . 11°,78048 . .	1.0711630

Sum, M. An. 104 46 44 ,1
Tr. An. —81 4 6 ,8

Dif the GR. } EQUATION } 23 42 37 ,3 required, agreeing with Dr. *Halley's Tables*; our Equation being greatest but by a *Second.*

PROPOSITION VI.

To determine the Eccentricity and other Dimensions of a Planet's or Comet's Orbit from the greatest Equation given?

EXAMPLE.

The greatest Equation *of* Mercury's *Orbit being* 23° 42′ 37″, *required his Eccentricity?*

RULE 9.

By a Table of natural Sines, the Sine of half the greatest Equation of a Planetary Orbit *(Radius or Semi-Transv. being Unity)* will be *very nearly* equal to the Eccentricity, in Orbits not much excentric; but in Orbits more or very excentric, as in that of *Mercury*, and the Orbits of *Comets*, the natural Sine of half the greatest Equation will be somewhat less than the true Eccentricity. So that the Eccentricity thus determined, for very eccentric Orbits, must be augmented, to compute the *greatest Equation* from thence, by the preceding *Example*, to correspond with the greatest Equation given. For the greatest Equation computed always augments with the Increase of Eccentricity.

NOW, from the near Eccentricity, found by a *Table* of natural Sines *(corresponding to the Semi-Transverse* = 1) determine the less Semi-*Axis*, it being √*Ap. Dist.* × *Perih. Dist.*; and then determine the *mean Proportional* betwixt the two Semi-*Axes*, which is the Distance of the *Planet* (or *Comet*) at that Time, of the greatest Equation, from the SUN.

THEN, Three Sides of a plain Triangle being given, *(the Distance of the Planet from the Sun and upper Focus, and Distance of the Foci)* determine the Angle of *true* Anomaly, (by *Rule* 8, preceeding) then the *eccentric* Anomaly, and lastly the *mean* Anomaly, corresponding; from whence the *greatest Equation* will be determined, *(being the Difference between the true and mean Anomalies)* nearly, according to the *assumed* Eccentricity.

NOW, Say, *as* the computed greatest Equation, *is to* the greatest Equation given, *so is* the assumed Eccentricity to the true Eccentricity *required.*

N. B. The *greatest Equations* and *Eccentricities*, nearly assumed, are in a *very near* Proportion to one another.

OTHERWISE, for *the very* ECCENTRIC ORBITS *of* COMETS.

RULE 10.

MAKE two Assumptions of *Eccentricities*, one *less* and the other *greater* than the true, (which you may easily do by having Regard to the *natural Sine* of ½ greatest Equation) and compute the greatest Equations, by the *foregoing Rules*, to both Eccentricities assumed. Then take their *Excess*, and *Defect*, by comparing them with the greatest Equation given; taking also the *Differences* of Eccentricities assumed.

Then say, As the Sum of *Excess* and *Defect* of the computed greatest Equation, above and under the given greatest Equation, *is to* the Difference of Eccentricities assumed, *so is* the Defect of the computed greatest Equation under the given greatest Equation, to a correspondent Difference of Eccentricity, to be *added* to the defective Eccentricity, for the true Eccentricity *required.*

N. B. IF BOTH the *computed greatest Equations* should happen to come out *too little*, or less than the *given* greatest Equation, you must subtract their *Defects* from one another, and *say*,

As the Difference of *Defects* of Equations, *is to* the Difference of assumed *Eccentricities*, *so is* the greater *Defect* of Equation, *to* the *Difference* of Eccentricity to be *added* to the less or greater defective Eccentricity, *respectively assumed*, for the true Eccentricity, *required.* According to THE METHOD of TRIAL and ERROR.

*** NOW, ½ greatest Equation given of ☿'s Orbit = 11° 51′ 18″ ½, whose natural *Sine* is ,205438 (by TABLE of SINES) for the Eccentricity of ☿'s Orbit, whereof you may observe that the 3 first Figures ,205 are correct (in Respect of the Semi-Transverse = 1) by what has been given and determined; but ,206 too much. *Therefore*, Let the *Eccentricity be assumed* ,2055 about one *ten-thousandth* Part greater than the Sine of ½ greatest Equation. In which *Assumption*, from ½ greatest Equation, you may sometimes reject *Seconds*, and take the *Sine of the next whole Minutes* greater, as of 11° 52′, when the Orbit, as at present, is much excentric, which Sine would be = ,2056349, or ,2056 at four Places.

Eccentricity assumed = ,2055, whence √1,2055 × ,7945 = √Aph. Dist. × Perih. Dist. = Sem. Conjugate; and √√1.2055 × ,7945 × 1 (for 1 equal Sem. Transverse) = 1.2055 × ,7945 $^{\frac{1}{4}}$ the *mean Proportional* between the Axes = ,989271 = direct Dist. ☿ fr. ☉, hence, 1,010729, = Dist. ☿ fr. upper Focus, F; and Dist. Foci = doub. Eccentricity = ,4110, being the three Sides of a given Triangle to *find the* ∠ *opposite to* ☿ F, or ∠ ☿ ☉ F, *the true Anomaly of* ☿ *at that Time?*

RULES for finding the REQUISITES of ELLIPTICAL ORBITS.

	Sides △.		
(By *Rule* 8.)	,989271 = ☉ ☿	fr. Sun to *Mercury*	
	,411000 = ☉ F	fr. Sun to upper *Focus*	
	1,010729 = ☿ F	fr. Mercury to upper *Focus*.	
	2,411000 = Sum.		

			Log^s.
½ . . . 1,205500 = Half = H	. . . .	co. Log.	9.9188328
,194771 = H — ☿ F (oppofite to Angle required)	.	co. Log.	0.7104757
,794500 = H — ☉ F	. . . .	Log.	9.9000939
,216229 = H — ☉ ☿	. . . .	Log.	9.3349139
		½ . .	19.8643163
	40° 32′ 34″,6 . . .	Tan.	9.9321581

Doubled 81 5 9,2 the ∠ at ☉, or *true Anomaly*.

NOW (by *Rule* 3.)	As √Perih. Dift. ,7945	co.	0.0499530
	To √Aph. Dift. 1,2055		0.0405836
	So Tan. ½ true An. found 40° 32′ 34″,6		9.9321581
	To Tan. ½ eccen. An. ☿ at Time of gr. Equation 46° 29′ 47″		10.0226947

Doubled 92 59 34, Eccent. An. at Time of greateft Equation.

(By *Rule* 4.)	*Radius* 57°,2957779		1.7581227
	Eccentricity ,2055		9.3128118
See p. 96.	*Conft.* Log. for the *Orbit*		1.0709345
	Correct eccentric An. 92° 59′ 34″ Supplement 87 0 26 . . .	Log. Sine	9.9994073 +
	Dif. bet. M. and Ecc. Anomalies + 11 45 29,6 . 11°,75823 . .		1.0703418

Sum, Mean Anom. 104 45 3,6
True Anom. 81 5 9,2 —

Dif. The *computed* gr. Equation . . 23 39 54,4 fr. *affumed* Eccentricity.
True gr. Equation . . 23 42 37,3 fr. *correct* Eccentricity.

Defect 2′ 43″ of Equation fr. *affumed* Eccentricity.

NOW, As 23° 39′ 54″ : 23° 42′ 37″ Or 85194″ : 85357″ :: *affumed* Eccentricity ,2055 : ,20589 the true Eccentricity, req^d.

*** *Hence,* it is evident, that by a careful and near Affumption of the Eccentricity, from a TABLE of *natural Sines*, a very great *Accuracy*, from Computation, will refult in determining the *true* Eccentricity of the Orbit from the *greateft Equation* given; and the Trouble of a Second Affumption and Operation, for any of the planetary Orbits will be thereby avoided.

REMARKS.

REMARK I. Some of the *French* Authors make the greateft *Equation* of Mercury to be not lefs than 24°, and Monf. *De la Caille*, particularly, in one Place of his Elements of Aftronomy, p. 81, makes it to be 24°. 3′. 5″. with Eccentricity 211165 to 1011276 the greater *Semi-axis*, being as ,20881 Eccentricity to 1 the Semi-tranfverfe. *Street* makes the Eccentricity of ☿ 7970 to 38710 the Semi-tanfverfe, the fame as ,20589 to 1, according to Dr. *Halley*; *Street's Mercurial Aftronomy* being reckoned very correct.

To determine the Principal Diameters of the Orbits of Planets?

They are to be taken in the *Subfefquiplicate* (or ⅔ Power) Proportion of the Periodic Times (by *Prop.* 15. *B. I. Newtonian Principia*) and then to be feverally augmented in the Proportion of the Sum of the Maffes of Matter in the Sun and each Planet to the Firft of Two Mean Proportionals betwixt that Sum and the Quantity of Matter in the Sun, by *Prop.* 60, *Book I, Principia*. They revolve in periodic Times that are in the Sefquiplicate Proportion of their Diftance from the Primary.

RULES for finding the REQUISITES of ELLIPTICAL ORBITS.

The *Eccentricities* and *Aphelions* of the Orbits of Planets are determined by *Prop.* 18. *B. I. Newtonian Principia.* That is, from *a Focus and the principal Axis given to describe elliptic Trajectories which shall pass through given Points, and touch right Lines given by Position.*

REMARK II. The foregoing Method of computing the Eccentricity of a Planet from the greatest Equation, tho' indirectly, is reckoned better for determining the Dimensions of the Orbits of *Planets*, than the Method by known Distances and true angular Velocities; because the Distances deduced will be more effected by Errors arising in observing the true *angular* Velocities than the Eccentricity will be by the Errors made in the greatest Equation. For (according to Monf. *De la Caille*) the Relation of *Mercury*'s Aphelion and Perihelion Distances is determined by a Comparison of an Arch of 1°. 3'. 35". ½ to another Arch of 27'. 23" whereof one Arch is little more than double the other. Whereas those Distances may be determined from the Comparison of an Angle of 24°. the Sum of Inequalities, down to no Angle or Inequality at all: *Mercury*'s Eccentricity causing all that Variation of Inequality from the Mean Motion, from Aphelion or Perihelion (where the Mean and true Motion is equal) to the *Points* of the two Mean Distances (in respect of the two *Semi-axes*) which Inequality, nor any Variation from the uniform Motion could happen, but by the Cause of the said Eccentricity of the Orbit.

REMARK III. To deduce, from Observation, the *greatest Equation* of *Mercury*, the Time must be determined when *Mercury* is in these Points of his Orbit, where the Distance (as has been observed) of that Planet from the Sun is a *mean Proportional* between the two *Semi-axes*, both before and after the Passage of *Mercury* through the *Apsides*.

This Time being when the *true* and *mean* Velocities are equal, *two Instants*, at the Distance of 24 Hours, must be found when *Mercury* shall have passed through 4°. 5'. 32". ½, by real diurnal Motion; being equal to the mean diurnal Motion of that Planet, according to Monsieur *De la Caille*.

Now, according to Monf. *De la Caille*'s Observations, 1740, for *Paris*, ☿'s true diurnal Motion about 15th *July*, and 4th *September*, is found to be 4°. 5'. therefore *interpolating* his Differences, 4° 14' 33"; 4° 6' 28"; 3° 58' 44"; between his Observations of 13, 14, 15 and 16th of *July*, the Time when 4° 5' 32" ½ is passed over by *Mercury*, will be found to be between *July* 14^d 2^h 49' and *July* 15^d 2^h 49^m; the *Middle* of which Time, will be *July* 14^d 14^h 49^m, for the *Instant* when *Mercury*'s true and mean Velocities were in Equality; or when that Planet was at his mean Dist. of the *Semi-axes*, from the Sun: (the other mean Dist. commonly so called, being the Length of the Sem. Tranverse from the Sun, at the End of the Conjugate) Now interpolating *Mercury*'s true *Places* on the 14, 15 and 16th of *July* (according to Monf. *De la Caille*'s Observations) *Mercury*'s true Place at the *Instant* of Equality of mean and true Velocity, *July* 14^d 14^h 49^m, will be 5^s 22° 57' 27".

Also interpolating the Differences between the Observations of *Mercury*'s true Places, 3, 4, 5 and 6 of *September*, (according to the Observations of the same Author) and you will find *Sept.* 3^d 22^h 14^m ½ for the Time of his mean Dist. (of the *Semi-axes*) from ☉, when his true and mean Velocities are equal, (the Velocities being least and greatest at Aphelion and Perihelion,) and his true Place at that Time, 11^s 4° 49' 10".

Now, the Difference between these two Places	5^s	22°	57'	27"
and	11	4	49	10
will be the true Motion, or Sum of *Mercury*'s *real* Velocities during the *Interval* of his Passage between his said *mean* Distances } Dif.	5	11	51	43
The Time of which aforesaid *Interval* is . . . . 52^d 7^h 25^m ½.				
During which Time *Mercury* would have described by uniform Motion (allowing 12^s in 87^d 23^h 15^m 32^s }	6^s	29°	58'	33"
	— 5	11	51	43
The *Difference* between these two Motions				
The *Half* of which is the *Sum* of all Mercury's *Inequalities*, and consequently is his *greatest Equation*	1	18	6	50
		24	3	25
Differing from the greatest Equation, in another Place of my Author, by + 20"				

Interpolation is not necessary for determining the *Instant* when a Planet is in its mean Distance (of the *Semi-axes*) if the Orbit is not very eccentric; it being then sufficient to compare its true Motion, at the Time when an Equality of its real and mean Velocities nearly happen, with the *Mean* Motion corresponding to that *Interval*.

For, on the 14th of *July* at Noon, ☿'s true Place was	5^s	14°	43'	43"
And on the 14th of *September* at Noon, his Mean Place was	7	2	48	7
Inequalities nearly in that Interval, the *Difference*	1	18	4	24
Half of which is the *greatest Equation*		24	2	12
Likewise, on *July* 15th at Noon, the true Place of ☿	5	10	37	15
And *September* 4th at Noon, the mean Place	6	28	42	35
Difference, *nearly* the Inequalities of Motion in that *Interval*	1	18	5	20
The *Half* of which is the *greatest Equation*		24	2	40

Which *Difference*, from the first *greatest Equation*, derived from the true Motion, is caused by the Inequality of Mercury's Velocity from the 14th to 15th of *July*.

But, in the planetary Orbits of *small Eccentricity*, the Inequality from Day to Day is hardly perceptible.

REMARK IV. The two Points of mean Motion in the former Interval, gives the Position of the Line of *Apsides*, those Points being equi-distant from that Line.

The middle Way between	5^s	22°	57'	27"
and	11	4	49	10
Sum	16	27	46	37
Will be the Place of *Mercury*'s Aphelion, *Half*	8	13	53	19

But the *Position* of the Line of *Apsides*, in general, may be had by determining two Points in the Orbit that have equal Velocities, which Method however is only fit for very *excentric* Orbits, wherein the *Inequalities* of Velocity, from Day to Day, are considerable enough to determine, with a Degree of Accuracy, the *Time* and *Place*, at which the Velocity would be *equal to a given Quantity*; without being much affected by the Errors of Observation. But, in Orbits of small Eccentricity, where the Velocities from Day to Day are nearly uniform, this Method will be useless.

PRINCIPLES

PRINCIPLES of the PLANETS PLACES and MOTIONS.

The SUN's Mean RADICAL PLACES and MOTIONS, in Revolutions Signs and Decimals.

Radical Years. Old and New Style.	Sun's mean Place from the Equinox.	Sun's mean Anomaly, from Equinox.	Sun's Apogee, from Equinox.	First * Aries, from Equinox.
Jan. 1. 1600 O. S. Jan. 1. 1600 N. S.	9s 20° 12′ 31″ our 9 10 21 8	6s 14° 11′ 32″ 6 4 20 11	3s 6° 0′ 59″ 3 6 0 57	0s 27° 35′ 10″ 0 27 35 9
Jan. 1. 1700 O. S. Jan. 0. 1700 N. S.	9 20 58 3 our 9 10 7 32	6 13 14 34 6 2 24 5	3 7 43 29 3 7 43 27	0 28 59 20 0 28 59 19
Our *Places* reduce to	*Newton*'s by — 0′ 3″ *Halley*'s . . — 0 10 *Morris*'s . . + 0 10 *Mayer*'s . . — 0 8 *Euler*'s . . — 2 12 *Bradley*'s wanting.	by . . . . — 0′ 3″ . . . + 5 10 . . . — 1 50 . . . — 1 8 . . . — 23 23	by . . 0′ 0″ . . — 5 20 . . + 2 0 . . + 1 0 . . + 21 11	*N. B.* The Eqs. foregoing being connected with those of Motion below, and both joined with our present Places will give those by others.
Equation of Places.	*N. B. Mayer*'s *Paris* Places ⊙ are but 23″ less than those corresp^t Places at *Greenwich*.			
Time forward.	Mean Motion ⊙.	Mean Motion ⊙ An.	Mean Motion ⊙ Apog.	Mean Motion 1 * ♈.
100 Julian Years.	100r 0s 0° 45′ 32″ our	99r 11s 29° 3′ 2″	0s 1° 42′ 30″	0s 1° 24′ 10″
Our Motions in 100 Julian Years, reduce, from 1600 and 1700, to Equation of Motion.	*Newton*'s by — 12″ 0‴ *Halley*'s . . + 0 20 *Mayer*'s . + 14 40 *Euler*'s . . + 28 0 *Bradley*'s wanting.	by . . + 1′ 18″ 0‴ . . . + 1 23 0 . . . — 2 15 20 . . . + 17 8 0	by . . — 1′ 30″ . . — 1 22 40‴ . . . + 2 30 . . . — 16 40	′ ″ . . — 0 50 . . + 0 10 . . + 1 40

Divide each Quantity above by 100, for the Equation of Motion to our Places for 1 Year, which multiplied by the Years from 1600 or 1700 will be the whole Equation of Motion, and connected with Equation of Place above will be the Equation of our present Places to others.

4 Julian Years. . . . *Our*	Decimals. +4r 0s,00101185185&c. exactly + 1′ 49″ 16‴ 48iv	Decimals. 4r — 0s,00126592592 exactly — 2′ 16″ 43‴ 12iv	Sign. +,0022777777 + 4′ 6″ exactly.	Sign. +,00187037037 + 3′ 22″ exactly.
Halley	+4r 0s,0010119753 exactly + 1′ 49″ 17‴ 36iv	4r — 0s.0012350617 exactly — 2′ 13″ 23‴ 12iv	Sign. +,002247037037 4′ 2″ 40‴ 48iv exactly	Sign. +,00185185 &c. 3′ 20″ exactly.
1 Com. Year, or 365 Days *Our*	Decimals. + 11s.9920392374 11s 99° 45′ 40″ 14‴&c.	Decimals. +11s.9914778627 11s.29° 44′ 39″ 36‴&c.	Sign. +,0005613747 56 1′ 0″ 37‴ 42iv &c.	Sign. +,0004672725 50′ 27″ 53‴ &c.
Halley	11s.9920392683	11s.9914778925	Sign. +,0005613758	Sign. +,0004626558 +49′ 57″ 56‴
Common Years 1. 2. 3. After Bissextile	— 14′ 19″ 45‴ — 28 39 31 — 42 59 17 Our.	— 15′ 20″ 23‴ — 30 40 46 — 46 1 10	+ 1′ 0″ 37‴ + 2 1 15 + 3 1 53 [*Halley*.	+ 0 50 / 0′ 50″ 28‴ + 1 40 / 1 40 55 + 2 30 / 2 31 23 Our
Day *Our*	Sign. +,0328549021 59′ 8″ 19‴ 45iv	Sign. +,0328533364 59′ 8″ 9‴ 47iv	Sign. +,000001538 0″ 58iv	Sign. +,0000012802 8‴ 17iv 44v
Hour and	Sign. +,0013689542 2′ 27″ 50‴, &c.	Sign. +,00136889 2′ 27″ 50‴ &c.	⊙'s Apogee + his Anom. = his Longitude. Therefore, ⊙ Longitude — his Ap. = his Anomaly.	† Therefore when it is *Leap-Year*, a Day, and Day's Motion must be *subtracted* for the Months of *Jan.* and *Feb.* Being the *New* and shorter Computation: the Lp.-Yr not taking Place till 29th of February.
Minute	Sign. +,0000228159 04 2″ 27‴ 50iv.	Sign. +,0000022814 2″ 27‴ 50iv	*N. B.* The *Rad.* Pls. for the Beginns. of Leap-Yrs are advanced a Day's Mot. †	
Second *Halley*	Sign. +.00000038026 2‴ 27iv 50v, &c.	Sign. +,00000038024 2‴ 27iv 50v &c.		
Revolution. *Our*	Decimals 365Ds.2423006021 365d 5h 48m 54s 46th 19fo. Mean Solar Year.	Decimals. 365Ds.259727107 365d 6h 14m 0s 25th 19fo Anomalistical Year.	Jul. Yrs. Dec. 21073,1707317 The same as a Revolution of ⊙ from ⊙'s An.	Jul. Yrs Dec. 25663,366336 Revn ⊙ à *. Dec. 365d,256532906 [6h 9m 24s 26th 33t
Halley	Decimals. 365Ds.2422996627 365d 5h 48m 54s 41th 27fo	Decimals. 365Ds.259398291 365d 6h 13m 32s 0th 43fo	*Sydereal* Year, or Revoln ⊙ from fixed *Star*.	365d,256391047 [6h 9m 12s 11t 1 &c.
4 Years Solar, anomalistical, or Sydereal, retard or advance of 4 Julian Years, according to —, or +, as to Month-days. *Our*	Day. —,030797591 44m 20s 54th 42fo	Day. +,038908428 56m 1s 41th 17fo 26ff	Our *Sydereal* Year greater than our *Solar* by 20m 29s 40th 14fo &c.	Day. +,026131624 36m 25s 46th 20fo
Hall.	Day. —,0308013403 44m 21s 14th 11fo Seasons go back, in 4 Yrs.	Day. +,037593164 54m 8s 2th 57fo Anl advance in 4 Yrs.	Dr. *Halley*'s Sydereal greater than his *Solar* by 20m 17s 30th &c.	Day. +,025564188 36m 48s 44th &c. *s advance, in 4 Yrs.
Com. Years 1. 2. 3. After Bissextile	+ 5h 48m 54s + 11 37 49 + 17 26 44 Seasons go forward each Yr.	*Vernal Equinox.* *Mar.* 9d 2h 16m 44s, 1700 *Mar.* 8 15 54 30, *O. S.* Or 19, *N.S. Halley* [1756	Our *Anomalistical* Yr greater than our *Solar* by 25m 5s 39th &c.	Dr. *Halley*'s *Anomalistical* greater than his *Solar* Year by 24m 37s 19th 16fo &c.

PRINCIPLES

PRINCIPLES and ELEMENTS of the PLANETS PLACES and MOTIONS, according to late IMPROVEMENTS.

The SUN's Mean MOTIONS continued, in SIGNS and DECIMALS.

TIME forward.	Mean Mot. Sun.	Mean Mot. Sun An.	Mean Motion Sun Ap.	Mean Mot. 1 * ♈.
ANOMALISTICAL YEAR. 365d 6h 14m 0s 25th 19fo. } Our	Decimals. +12s.00057254609 12s 0° 1′ 1″ 50‴ 5iv	+ 12s	Sign. +,0005694595 1′ 1″ 30‴ 5iv &c.	Sign. +,0004676049 50″ 30‴ 4iv &c.
365d 6h 13m 32s 0th 43fo } Halley	Decimals. 12s.0005617737 12s 0° 1′ 0″ 40‴ 17iv	+ 12s	Sign. +,00056177371 1′ 0″ 40‴ 17iv &c.	Sign. +,00046309122 0″ 0‴ 49iv &c.
LUNATION. Dec. 29Ds.53059085119 +12h 44m 3s 2th } our	Sign. +,97022467137 29° 6′ 24″ 15‴ &c.	Sign. 36292 +,97017~~[illegible]~~ 29° 6′ 19″ ~~[illegible]~~	Sign. +,00004542100 4″ 54‴ 19iv &c.	Sign. +,00003780506 4″ 4‴ 58iv &c.
Decimals. 29Ds.5305908511 +12h 44m 3s 3th } Halley.	Sign. +,9702246715135 29° 6′ 24″ 15‴ &c.	Sign. +,9701792530808 29° 6′ 19″ 21‴ &c.	Sign. +,0000454184 4″ 54‴ 19iv &c.	

The MOON's Mean RADICAL PLACES and MOTIONS, in REVOLUTIONS, SIGNS and DECIMALS.

Radical YEARS, Old and New Style.	Moon's mean Places from the Equinox.	M Pl. Moon's mean Anomaly, fr. Equinox.	M. Pl. Moon's Apogee, fr. Equinox.	M. P.. Moon's ascending Node fr. Equinox.
Jan. 1. 1600 O. S. *Jan.* 1. 1600 N. S.	7s 28° 7′ 42″ 3 16 21 52	1s 19° 41′ 47″ 9 9 2 48	6s 8° 25′ 55″ 6 7 19 4	10s 0° 55′ 28″ 10 1 27 14
Jan. 1. 1700 O. S. *Jan.* 0. 1700 N. S.	6s 5° 58′ 7″ 1 11 1 42	8s 8° 20′ 57″ 3 14 38 4	9s 27° 37′ 10″ 9 26 23 38	5s 16° 44′ 13″ 5 17 19 10
Our Places reduce to . . . *Equation* of *Places*.	*Newton*'s by —0′ 10″ *Halley*'s . . —1 10 *Morris*'s . . 0 0 *Mayer*'s . . —0 20 *Euler*'s . . +0 20 *Bradley*'s wanting. *N.B. Mayer*'s *Paris*-Places were reduced to *Greenwich*.	by . —3′ 10″ . . —4 10 . . . +2 0 . . —1 14 . . +10 50	by . +3′ 0″ . . +3 0 . . . —2 0 . . +0 54 . . . —10 30	by . —0′ 10″ . . —1 10 . . . . +4 1 . . . +1 50
TIME forward.	Mean Motion Moon.	Mean Motion ☽'s Anom.	Mean Motion ☽'s Apogee.	Mean Motion ☽'s Node.
100 Julian Years.	1336r 10s 7° 50′ 25″	1325r 6s 18° 39′ 10″	11r 3s 19° 11′ 15″	5r 4s 14° 11′ 15″
Our Motions in 100 Julian Years from ~~1600~~ [illegible] 1700 reduce to . *Equation* of *Motion*.	*Newton*'s . . 0′ 0″ *Halley*'s . . 0 0 *Morris*'s . . 0 0 *Mayer*'s . +1 55 *Euler*'s . . 0 0 *Bradley*'s wanting.	by . . . 0′ 0″ . . . . . 0 0 . . . . . 0 0 . . . . +1 55 . . . . . 0 0	by . . . 0′ 0″ . . . . 0 0 . . . . . 0 0 . . . . 0 0 . . . . . 0 0	. . . . 0′ 0″ . . . . . 0 0 . . . . 0 0 . . . . . 0 0 . . . . . 0 0

Divide any Quantity, variable from our own Motn, by 100, for the *Eq.* of *Mot.* to our Pls for 1 Yr, which ×d for the Yrs from ~~1600 and~~ 1700, will be the whole *Equat. of Motion*, and connected with Equat. of Places above will be the absolute Eqn. of our Present Places to those of others

[illegible] Julian Years . . .	Decimals. +53r 5s,6904537037 +5s 20° 42′ 49″ exactly.	Decimals. +53r 0s.26487037037 +0s 7° 56′ 46″ exactly.	Decimals. +5s.4255333333 &c. +5s 12° 46′ 3″ exactly.	Decimals. —2s.578916666 &c. —2s 17° 22′ 3″ exactly.
365 Days	Decimals. +13r 4s,3128101314 13r 4s 9° 23′ 3″ 29‴ &c.	Decimals. +13r 2s.9573427 13r 2s 28° 43′ 13″ &c.	Decimals. +1s.3554674314 1s 10° 39′ 50″ 29‴ &c.	Sign. —,6442878735 19° 19′ 43″ 11‴ &c.
Com. Years. 1 2 3	+ 4s 9° 23′ 3″ + 8 18 46 7 + 0 28 9 10	+ 2s 28° 43′ 13″ + 5 27 26 26 + 8 26 9 39	+ 1s 10° 39′ 50″ + 2 21 19 41 + 4 1 59 32	— 0s 19° 19′ 43″ — 1 8 39 26 — 1 27 59 10
Day.	Sign. +,4392131784 13° 10′ 35″ 1‴ &c.	Sign. +,435499569 13° 3′ 53″ 57‴ &c.	Sign. +,0037136094 6′ 41″ 4‴ &c.	Sign. —,0017651722 3′ 10″ 38‴ &c.
Hour.	+,018300549 32′ 56″ 27‴ &c.	+,018145815 32″ 39‴ 44iv &c.	+,000154734 16″ 43‴	—,0000735487 7″ 56‴ 35iv
Minute.	+,000305009 32″ 56‴ 27iv.	+,00030243 32″ 39‴ 44iv.	+,000002579 16‴ 43iv	—,0000012258 7″ 56iv
Second.	+,0000050 83 32‴ 56iv &c.	+,0000050405 32‴ 39iv &c.	+,000000043 16iv 56v	—,0000002043 7iv 56v
Periodical REVOLUTION, of	Decimals. 27Ds.321584572 ☽. +7h 43m 4s 54th	Decimals. 27Ds.554562284 An. ☽. +13h 18m 34s 11th	Ds. Decimals. 3231.357611277 Ap. ☽. +8h 34m 57s 36th	Ds Decimals. 6798,2038173 ☊. +4h 52m 52s 11th
Synodical REVOLUTION. { ⊙ and	Decimals. 29Ds.53059085119 ☽. + 12h 44m 3s 2th	Decimals. 29Ds.98026468005 An. +23h 31m 34s 52th &c.	Ds 411.78632769861 &c. Ap. +18h 52m 18s 42th &c.	Ds 346,6197060918 &c. ☊. + 14h 57m 22s 13th &c.
LUNATION. Mot.	Decimals. +12s.9702246554 &c. ☽. 29° 6′ 24″ 15‴ &c.	Decimals. +12s.860559558 &c. An. 25° 49′ 0″ 25‴ &c.	Sign. +,10966509748 Ap. 3° 17′ 23″ 49‴	Sign. —,052126578 &c. ☊. 1° 33′ 40″ 40‴ &c.
ANOMALISTICAL YEAR.	Decimals. +13r 4.42 6741279 12° 48′ 8″ 3‴	Decimals. +13r 3s.07031655 2° 6′ 33″ 32‴	+0r 1s.355430729 10° 3′ 58″ 39‴	—0r 0s.644745,501 19° [illegible] 32″ [illegible] &c.
☽ à ⊙ in An. Year.	+12r 4s.4261795051 12° 47′ 7″ 23‴ &c.	{ ⊙ à ☊ in a Lunation. }	1s.02235124049 + 0° 40′ 13″ 59‴	

ELEMENTS of the PLANETS PLACES and MOTIONS; according to late IMPROVEMENTS. In REVOLUTIONS, SIGNS, and DECIMALS.

The Mean PLACES and MOTIONS of the MOON from the SUN, and Time of the Mean NEW MOON in JANUARY, *&c.*

	Our Radixes.		According to Dr. HALLEY.		
RADICAL YEARS.	Mean Place Moon à Sun.	Mean New Moon.	Mean Dist. Moon à Sun.	Mean New Moon.	
Jan. 1. 1600 O.S. Jan. 1. 1600 N.S.	10s 7° 55′ 11″ 6 6 0 44	Jan. 5d 6h 31m 52s Jan. 15 6 31 52	10s 7° 54′ 11″ 6 5 59 44	Jan. 5d 6h 33m 50s Jan. 15 6 33 50	O.S. N.S. 1600
Jan. 1. 1700 O.S. Jan. 0. 1700 N.S.	8 15 0 4 4 0 54 10	Jan. 9d 14h 42m 44s Jan. 19 14 42 44	8s 14° 59′ 4″ 4 0 53 11	Jan. 9d 14h 44m 42s Jan. 19 14 44 42	O.S. N.S. 1700
TIME forward.	Mean Mot. Moon à Sun.	Advce & Retrt. of Lunans.	Mean Mot. Moon à Sun.	Mean Lunations.	
100 Julian Years.	1236r 10s 7° 4′ 53″	+4d 8h 10m 52s 16th 29fo	1236r 10s 7° 4′ 52″ 40‴	1236,853	Equn Motn. — 20‴, for 100 Years, fr. 1600 or 1700.
4 Julian Years.	49r 5s 20° 40′ 59″ 43‴ 12iv 49r.5s.68944185185	— 14d 0h 1m 30s 34th — 14d.0010482961	49r 5s 20° 40′ 59″ 42‴ 24iv 49r.5s.6894417284	 49.47412	
365 Days.	+12r.4s.320770894	— 10d.6329097868	+12r.4s.3207708631	12.36 nearly.	And Equation of Dist. Moon à Sun, — 1′, being connected with our ☽ à ☉, will correspond with *Halley*'s ☽ à ☉ very nearly.
Common Yrs. 1. 2. 3. After Bissextile.	+ 4s 0° 37′ 23″ 15‴ + 8 19 14 46 30 + 0 28 52 9 45	— 10d 15h 11m 23s, &c. — 21 6 22 47 — 2 8 50 7 our.	+ 4s 9° 37′ 23″ 15‴ + 8 19 14 46 30 + 0 28 52 9 45	12. 25. nearly. 37.	
Day.	Sign. + ,4063582763 12° 11′ 26″ 41‴, &c.	*Mayer.* Sun's Mot.	*Mayer.* Moon's Mot. 4 Years. 53r 5s 20° 42′ 53″ 36‴	*Mayer*'s Solar Year.	
Hour.	+ ,016931595 30′ 28″ 36‴, &c.	100 Julian Years. 100r 0s 0° 45′ 46″ 40‴	Sun's Motion. =1200s.0254320987	Decimals. 365d.24225926899 5h 48m 51s 12th	
Minute.	+ ,000282193 30″ 28‴ 36iv	4 Julian Years. 4r 0s 0° 1′ 49″ 52‴	Sun's Mot. = 48s 0010172839	Moon's Mot. *Mayer.* 27d.3215827586 Perl. Rev.	
Second. our.	+ ,000004703 30‴ 28iv 36v, &c.	363 Days. 11s 29° 45′ 40″ 23‴, &c.	Sun's Mot. = 11s.9920405945	Synodical Revn with Sun. 29d 5305890025	
1. Lunation. 29d 12h 44m 3s 3th.	Sun à Moon's Apogee. ,86055959174 25° 49′ 0″ 26‴, &c. Halley.	Sun à Moon's Node. 1s.022351251199 1s 0° 40′ 13″ 56‴	Accurately. *Lunations.* In 365 Days . . 12.360064241 4 Jul. Yrs. . . 49.474120153 223 Lunations . . *Halley*	Sun à Moon's Node. . . . . 12s.636327110 . . . . 11s.984329017	

The *Mean* PLACES and MOTIONS of *Mercury*, *Venus*, *Mars*, and *Jupiter*.

RADICAL YEARS.	Mean Places ☿, from Equinox.	M. Places *Aph.* ☿.	M. Pls. *Node* ☿.	Mean Places ♀, from Equinox.	M. Places *Aph.* ♀.	M. Pls. *Node* ♀.
Jan. 1. 1600 O.S. Jan. 1. 1600 N.S.	0s 9° 10′ 8″ 10 28 14 43	8s 11° 15′ 48″ 8 11 15 47	1s 13° 17′ 0″ 1 13 16 59	4s 5° 57′ 42″ 3 19 56 24	10s 4° 57′ 16″ 10 4 57 14	2s 13° 6′ 13″ 2 13 6 12
Jan. 1. 1700 O.S. Jan. 0. 1700 N.S.	2s 23° 12′ 1″ 1 8 11 4	8s 12° 43′ 25″ 8 12 43 24	1s 14° 40′ 20″ 1 14 40 19	10s 25° 9′ 34″ 10 7 32 8	10s 6° 31′ 29″ 10 6 31 27	2s 13° 57′ 53″ 2 13 57 52
TIME forward.	Mean Motion ☿.	M. Mot. Ap. ☿.	M. Mot. Node ☿.	Mean Motion ♀.	M. Mot. Ap. ♀.	M. Mot. Node ♀.
100 Julian Years.	415r 2s 14° 2′ 13″	0s 1° 27′ 37″	0s 1° 23′ 20″	162r 6s 19° 11′ 52″	0s 1° 34′ 13″	0s 0° 51′ 40″
4 Julian Years.	16r 7s 8° 57′ 41″ 19‴ 12iv	3′ 30″ 16‴ 48iv	0s 0° 3′ 20″	6r 6s 0° 46′ 4″ 28‴ 48iv	3′ 46″ 7‴ 12iv	0s 0° 2′ 4″
See Phil. Transact. No. 386.	Decimals. +199s.29871593592	Degrees. +,05841111, &c.	Degrees. +,0555555, &c.	Decimals. + 78s.02559703703	Degrees. &c. +,0628111111	Degrees. +,03444444, &c.
365 Days.	Decimals. + 49s.79057584733	+ 52″ 34‴	+ 50″	Decimals. + 19s.49304717215	+ 56″ 31‴	+ 0′ 31″
Common Yrs. 1. 2. 3. After Bissextile.	+ 1s 23° 43′ 2″ 11‴ + 3 17 26 4 22 + 5 11 9 6 33	+ 0′ 52″ + 1 45 + 2 37	+ 0′ 50″ + 1 40 + 2 30	+ 7s 14° 47′ 29″ 5‴ + 2 29 34 58 10 + 10 14 22 27 15	+ 0′ 56″ + 1 53 + 2 49	+ 0′ 31″ + 1 2 + 1 33
Day.	Sign. + ,1364125365 4° 5′ 32″ 33‴ 14iv	Seconds. + ,144 8‴ 38⁗ 24v	Seconds. + ,137 8″ 13‴ 12iv	Sign. + ,05340560869 1° 36′ 7″ 48‴ 20iv	Seconds. + ,155 9‴ 18⁗	Seconds. + ,085 5‴ 6⁗
Hour.	Sign. + ,0056838517 10′ 13″ 51‴ 22iv	Seconds. + ,006 21⁗ 36v	Seconds. +,00228333, &c. 8‴ 13iv 12v	Sign. + ,00222523369 4′ 0″ 19‴ 30iv	Seconds. +,00645833, &c. 23⁗ 15v	Seconds. +,00354166, &c. 12⁗ 45v
Minute.	Sign. + ,0000947308 10″ 13‴ 51iv, &c.			Sign. + ,00003708722 4″ 0‴ 19iv, &c.		
Second.	Sign. + ,0000015788 10‴ 14iv, fere.			Sign. + ,0000006182 4‴ 0iv, &c.		

P. 120. 2d Col. ☉ M. Motn.

Com. Yrs. { 1 . . — 14′ 19″ 45‴ ; 2 . . — 28 39 31 ; 3 . . — 42 59 17 }

EMENDATIONS *as above.*

P. 119. l. 2. For *Trajections* read *Trajectories.*

l. 11. For, where the m. and true *Motions are equal,* read, where the m. and true *Anomalies are equal.*

ELEMENTS

ELEMENTS of the PLANETS PLACES and MOTIONS, according to our late IMPROVEMENTS.

In REVOLUTIONS, SIGNS and DECIMALS.

The Mean PLACES and MOTIONS of MARS and JUPITER.

RADICAL YEARS.	Mean Places ♂ from Equinox.	M. Pl. Aph. ♂.	M. Pls. Node ♂.	Mean Places ♃ from Equinox.	M. Pls. Aph. ♃.	M. Pls. Node ♃.
Jan. 1. 1600 O.S.	3s 25° 26′ 49″	4s 28° 36′ 40″	1s 16° 21′ 22″	4s 10° 20′ 24″	6s 9° 34′ 24″	3s 5° 34′ 10″
Jan. 1. 1600 N.S.	3 20 12 22	4 28 36 38	1 16 21 21	4 9 30 31	6 9 34 22	3 5 34 9
Jan. 1. 1700 O.S.	5s 27° 9′ 9″	5s 0 33 20	1s 17° 24′ 42″	9s 16° 48′ 35″	6s 9° 33′ 48″	3s 7° 24 10″
Jan. 0. 1700 N.S.	5 21 23 15	5 0 33 18	1 17 24 41	9 15 53 43	6 9 33 46	3 7 24 0
TIME forward.	M. Mot. ♂ from Eqx.	M. Mot Aph. ♂.	M. Mot. Node ♂.	Mean Motion ♃.	M. Mot. Ap. ♃.	M Mot. Node ♃.
100 Julian Years.	53r 2s 1° 42′ 20″	0s 1° 56′ 40″	0s 1° 3′ 20″	8r 5s 6° 28′ 11″	0s 2° 0′ 0″	0s 1° 23′ 20″
4 Julian Years.	2r 1s 15° 40′ 5″ 36‴ Decimals +25s.52227407407	0s 0° 4′ 40″ Deg. +,07777777 &c	0s 0° 2′ 32″ Degs. 0,0422222 &c.	0r 4s 1° 27′ 31″ 38‴ 24iv Decimals. +4s.04862629629	0s 0° 4′ 48″ Degs. +,08	0s 0° 3′ 20″ Degs. +,0555555 &c.
365 Days.	Decimals. +6s.37620125738	+ 1′ 10″	+ 38″	Decimals. +13s.01146379045	+ 1′ 12″	+ 50″
Com. Years. 1.	+ 6s 11° 17′ 19″ 44‴	+ 1′ 10″	+ 0′ 38″	+1s 0° 20′ 38″ 5‴	+ 1′ 12″	+ 0′ 50″
2.	+10 22 34 19 28	+ 2 20	+ 1 16	+2 0 41 16 10	+ 2 24	+ 1 40
3. After Bissextile.	+ 7 3 51 29 12	+ 3 30	+ 1 54	+3 1 1 54 15	+ 3 36	+ 2 20
Day	Sign. +,01746904454 31′ 26″ 39‴ 24iv.	Secs. +,192 11″ 31‴ 12iv	Secs. +,104 6″ 14‴ 24iv	Sign. +,00277113367 4′ 59″ 16‴ 56iv	Secs. +,197 11″ 47‴ 12iv	Secs. +,137 8″ 13‴ 12iv
Hour	Sign. +,00072787685 1′ 18″ 6‴ &c.	Secs. ,008 28‴ 48iv	Secs. ,00433 &c. 15‴ 34iv.	Sign. +,0001154639 12″ 28‴ 12iv	Secs. ,00820833 &c. 29‴ 32iv &c.	Secs. ,00570833 &c. 20‴ 33iv
Minute	Sign. +,00001213128 1″ 18‴ 36iv			Sign. +,0000019244 12‴ 28iv.		
Second	Sign. +,00000020218 1‴ 18iv &c.			Sign. +,000000032076 12iv 28v &c.		

The *Mean* PLACES and MOTIONS of SATURN.

RADICAL YEARS.	Mean Places ♄	M. Pls Node ♄.	M. Pls. Node ♄.
Jan. 1. 1600 O.S.	6s 16° 10′ 32″	8s 28° 31′ 56″	3s 18° 51′ 46″
Jan. 1. 1600 N.S.	6 15 50 26	8 28 31 54	3 18 51 45
Jan. 1. 1700 O.S.	11s 9° 16′ 32″	8s 28° 33′ 10″	3s 21° 5′ 6″
Jan. 0. 1700 N.S.	11 8 54 26	8 28 33 18	3 21 5 5
TIME forward.	Mean Motion ♄.	M. Mot. Ap. ♄.	M. Mot. Node ♄
100 Julian Years.	3r 4s 23° 6′ 0″	0s 2° 13′ 20″	0s 0° 30′ 0″
4 Julian Years.	1s 18° 55′ 26″ 24‴ Decimals. +1s.6308	0s 0° 5′ 20″ +,088888 &c.	0s 0° 1′ 12″ Degs. +.02
365 Days.	Decimals. 0s.4074209445	+ 1′ 10″	+ 18″
Com. Years. 1.	0s 12° 13′ 21″ 27‴	+ 1′ 20″	+ 18″
2.	0 24 26 42 54	+ 2 40	+ 36
3. After Bissextile.	1 6 40 4 21	+ 4 0	+ 54
Day	Sign. +,00111162217 2′ 0″ 33‴ 6iv	Secs. +,219 12″ 8‴ 24iv	Secs. +,049 2″ 56‴ 24iv
Hour	Sign. +,0000465092 5″ 1‴ 22iv	+,009125 32‴ 57iv.	+,002041666 7‴ 20iv
Minute	Sign. +,000007751 5‴ 1iv 22v		
Second	Sign. +,0000000129 5iv 1v &c.		

The PLANETS Mean Periodical REVOLUTIONS.

	Ds Decimals	Ds	h	m	s	th
☿	87.968454378	87	23	14	34	27
♀	224.695493091	224	16	41	30	36
♂	686.929383687	686	22	18	18	45
♃	4330.357686018	4330	8	35	4	4
♄	10750.551876380	10750	13	14	4	7

The PLANETS Mean Synodical REVOLUTIONS with each other.

		Ds Decimals.	Ds	h	m	s	th
☽ w.	☿	39.6300348836	39	15	7	15	1
	♀	31.1035889370	31	2	29	10	5
	☉	29.5305908511	29	12	44	3	3
	♂	28.4532706809	28	10	52	42	35
	♃	27.4950595246	27	11	52	53	8
	♄	27.3911968963	27	9	23	19	24
☿ w.	♀	144.5662497937	144	13	35	23	59
	☉	115.8775019497	115	21	3	30	10
	♂	100.8882436086	100	21	19	4	14
	♃	89.7925323996	89	10	1	12	38
	♄	88 6942117894	88	16	39	39	54
♀ w.	☉	583.9214751501	583	22	0	55	27
	♂	333.9217217235	333	22	7	16	45
	♃	236.9926725095	236	23	49	26	54
	♄	229.4920685698	229	11	48	34	43
☉ w.	♂	779.9370204795	779	22	29	19	5
	♃	398.8861976230	398	21	16	7	28
	♄	378 0875534780	378	2	6	4	37
♂ w.	♃	816.4425616661	816	10	37	17	19
	♄	733.8182627679	733	19	38	17	54
♃ w.	♄	7251.1412534284	7251	3	23	24	17

TO determine the Place of a Planet at any Time by its periodical *Revolution, and the Place of that Planet given for some one Time* Before *or* After?

RULE. Divide the Time, in Days and Decimals, *after* or *before* the *radical* Time of the Place given, by the Time of the Planet's *periodical* Revolution, in *Days* and *Decimals*, and the Quotient will be the *Number of Revolutions* perform'd in that *Interval*, which turned into *Signs, Degrees, Minutes*, &c. (neglecting whole Revolutions) and added or subtracted to or from the mean radical Place, according as the Time of the Place sought is after or before the Time of the Place given, and you will have the mean *Place required:* Which Operation may be readily performed by a Table of Logarithms to many Places. *See Examples for finding the Mean Places from these given, further on.*

ELEMENTS of the PLANET's PLACES and MOTIONS; according to late IMPROVEMENTS. In REVOLUTIONS, SIGNS and DECIMALS.

MEAN DISTANCES of the PLANETS from the SUN, Eccentricities and Inclinations of their Orbits, with their Aphelions and Nodes from 1 * ♈.

PLANETS.	By Mr. STREET's Tables.		Dr. HALLEY's Tables			Mr. STREET's Tables.		
	Mean Dist. from Sun.	Eccentricity.	Mean Dist. from Sun.	Eccentricity.	greatest Equan.	Aph. à 1 * ♈.	☊ à 1 * ♈.	Incl. Orb.
♄	953800 As 1	54700 to ,0573495	954002 1	54386 ,05700322	6° 32′ 4″	7s 28° 30′ 0″	2s 22° 30′ 0″	2° 30′
♃	520110 1	25050 ,048163	520093 1	25072 ,0482192	5 31 36	5 9 50 0	2 8 0 0	1 20
♂	152369 1	14100 ,0925385	152369 1	14170 ,09263936	10 40 2	4 1 12 0	0 19 10 0	1 52
♀	72333 1	517 ,0071475	72334 1	504 ,0069813	0 48 0	9 5 0 0	1 15 16 0	3 24
☿	38710 1	7970 ,20589	38710 1	7970 ,20589	23 42 36	7 13 48 0	0 15 42 0	6 14

THE FIXED STARS *being at Rest, the periodic Times of the* Five Primary Planets, *and of the Earth, about the Sun, (describing* Areas *proportional to the Times of Description) are in the* Sesquiplicate (or $1\frac{1}{2} = \frac{3}{2}$ Power) *Proportion of their mean Distance from the* SUN. Princip. B. III.

AUTHORITIES.	The *Periodic* Times, in Respect of the *Fixed Stars*, of the Planets and Earth revolving about the SUN.					
	♄	♃	♂	⊖ Orb.	♀	☿
According to Sir *Isaac Newton*.	Days 10759,275	Days 4332,514	Days 686,9785	Days 365,2565	Days 224,6176	Days 87,9692
	The Mean Distances of the Planets and Earth from the SUN.					
	Parts.	Parts.	Parts.	Parts.	Parts.	Parts.
To *Kepler*	951000	519650	152350	100000	72400	38806
To *Bullialdus*	954198	522520	152350	100000	72398	38585
To periodic Times	954006	520096	152369	100000	72333	38710

The MEAN PLACES and MOTIONS of the Four SATELLITES of JUPITER.

RADICAL YEARS.	Mean Place 1, from Equinox.	Mean Place 2, from Equinox.	Mean Place 3, from Equinox.	Mean Place 4, from Equinox.	M. Place Apsis 4, from Equinox.
Jan. 1. 1600 O.S. *Jan.* 1. 1600 N.S.	9s 7° 16′ 20″ 1 12 22 57	11s 24° 9′ 29″ 2 0 24 36	9s 25° 17′ 11″ 5 2 6 37	8s 19° 51′ 40″ 1 14 9 0	8s 27° 48′ 6″ 8 27 47 6
Jan. 1. 1700 O.S. *Jan.* 0. 1700 N.S.	5s 2° 16′ 20′ 2 13 53 37	3s 18° 31′ 59″ 2 13 24 37	11s 16° 48′ 51″ 5 3 19 13	3s 14° 41′ 40″ 7 17 24 44	10s 27° 48′ 6″ 10 27 47 0
TIME forward.	Mean Motion 1.	Mean Motion 2.	Mean Motion 3.	Mean Motion 4.	M. Motion Aps. 4.
100 *Julian* Years.	20645r 7s 25°	10285r 3s 24° 22′ 30″	5101r 1s 21° 31′ 40″	2188r 6s 24° 50′	2s 00 0′ 0″
4 *Julian* Years.	825r 9s 27° 24′ 0″ +825r 9s.91333333	411r 4s 28° 34′ 30″ +411r 4s.9525	204r 2s 14° 3′ 40″ +204r 2s.46870378	87r 6s 15° 23′ 36″ +87r 6s.513111111	0s 2° 24′ 0″ +,08
365 Days.	+206r 3s.782591832	+402r 9s.503335044	+51r 0s.19786234	+21r 10s 448518518	+,02 fere
Com. Years 1 2 3 After Bissextile.	+ 3s 23° 28′ 40″ + 7 16 57 20 +11 10 26 0	+9s 11° 48′ +6 23 36 +4 5 24	+ 0 5° 56′ 9″ + 0 1 52 18 + 0 17 48 27	+10s 13° 27′ 20″ + 8 26 54 40 + 7 10 22 0	+ 0° 36′ + 1 12 + 1 48
Day	+6s.782966 6s 23° 20′ 20″ 19‴	+3s.379159822 3s 11° 22′ 29″ 15‴ &c.	+1s.67725441 3s 0° 10′ 3″ 28‴ &c.	+,719037037 0s 21° 34′ 16″ &c.	+,00005479 5″ 55‴
Hour	+,2826235 8° 28′ 43″ 20‴ &c.	+,140798325 4° 13′ 26″ 13‴ &c.	+,0698856 2° 5′ 47″ 38‴ &c.	+,029959876 53″ 55‴ 40iv	In *Jan.* and *Feb. Leap Year*, compute for a Day and Day's Motion less than the given time. See *Tab.* farther on of Ds. fr. *Jan.* 1, inclus.
Minute	+,0471039 8′ 28″ 43‴ &c.	+,002346638 4′ 13″ 26‴ &c.	+,00116476 2′ 5″ 47‴ &c.	+,000499331 53‴ 55iv	
Second.	+,00007850 8″ 28‴ 43iv &c.	+,00003911 4″ 13‴ 26iv &c.	+,00001941 2″ 5‴ 47iv &c.	+,000008322 53iv 55v &c.	
Time of a *Revolution*.	128 1d,7691375706 1d 18h 27m 33s 29th 9fo 57fi	128 3d,551178586 3 3d 13h 13m 41s 49th 47fo 28fi	128 7d,1545496471 7d 3h 42m 33s 5th 22fo 14fi	128 16d6889873287 16d 16h 32m 8s 30th 18fo 43fi	128 600 *Julian* Years.

Of

Of JUPITER's FOUR SATELLITES.

THE fixed Stars *being at rest, the periodic Times of the* Circumjovial Satellites, *or* MOONS *(describing Areas round* Jupiter, *proportional to the Times of Description) are in the* sesquiplicate *(or* $1\frac{1}{2} = \frac{3}{2}$ *Power) Proportion of their mean Distances from the Center of* Jupiter.

AUTHORITIES.	1	2	3	4
	Periodic Times of the *Satellites* of *Jupiter*.			
	d h m s	d h m s	d h m s	d h m s
According to Sir *Isaac Newton*	1 18 27 34	3 13 13 42	7 3 42 36	16 16 32 9
to Dr. *Halley*'s Tables	1 18 27 33	3 13 13 42	7 3 42 33	16 16 32 8
	Distances of *Jupiter*'s *Satellites* from his Center.			
From the Observations of *Borelli*	$5\frac{2}{3}$ Rad. ♃	$8\frac{2}{3}$ Rad. ♃	14 Rad. ♃	$24\frac{2}{3}$ Rad. ♃
Townley, by Micrometer	5,52	8,78	13,47	24,72
Cassini, by the Telescope	5	8	13	23
Cassini, by Eclipses of Satellites	$5\frac{2}{3}$	9	$14\frac{23}{60}$	$25\frac{3}{10}$
From the periodic Times.	5,667	9,017	14,384	25,290

REMARKS.

MR. POUND determined, by the Help of excellent Micrometers, the Diameters of *Jupiter*, and the Elongation of his Satellites, thus.

The *greatest* heliocentric Elongation of the 4th *Satellite* was taken with a *Micrometer*, in a 15 Foot Telescope, and, at a mean Dist. of ♃ à ☉, was found about 8′ 16″. The *Elongation* of the 3d *Satellite* was taken with a *Micrometer* in a Telescope of 123 Feet, at the same Distance of *Jupiter* from the Earth, and was found 4′ 42″. The *greatest Elongation* of the other *Satellites*, at the same Dist. of ♃ à ☉, are determined, from the *periodic Times*, to be 1′ 56″ 47‴ and 1′ 51″ 6‴.

The Diameter of *Jupiter*, taken with the *Micrometer*, in an 123 Foot Telescope, several Times, and reduced to *Jupiter*'s mean Distance from the Earth, proved always less than 40″, never less than 38″, generally 39″. This Diameter in shorter Telescopes is 40″, or 41″. For *Jupiter*'s *Light* is a little *dilated* by the unequal Refrangibility of the Rays, which Dilatation bears a less *Ratio* to the Diameter of *Jupiter* in the longer and more perfect Telescopes than in those which are shorter and less perfect.

The Times in which the 1st and 3d Satellites passed over *Jupiter*'s Body, were observed from the Beginning of the *Ingress* to the Beginning of the *Egress*, and from the complete *Ingress* to the complete *Egress*, with the long Telescope. And from the *Transit* of the *first* Satellite, the Diameter of *Jupiter*, at its mean Distance from the *Earth*, came out $37\frac{1}{8}$″, and from the *Transit* of the *Third* $37\frac{3}{8}$″. There was observed also the Time in which the *Shadow* of the *first Satellite* passed over *Jupiter*'s Body, and thence the Diameter of *Jupiter*, at its mean Distance from the Earth, came out about 37″. If we suppose its Diameter to be $37\frac{1}{4}$″, very nearly, then the greatest *Elongation* of the

	1	2	3	4	*Satellites*,
will be respectively equal to	5,965	9,494	15,141	26,63	Radii of ♃.

See Principia, B. III. *Phænomenon* 1.

Of the celebrated Dr. BRADLEY'*s Observations, concerning the* SITUATIONS *and* MOTIONS *of the* SATELLITES *of* JUPITER.

THIS indefatigable and accurate Observator of the Heavens, has compared the oldest and most accurate Observations he could procure, with his own modern Observations of *Jupiter*'s Satellites taken at *Wansted*. Who has likewise compared the Observations at the Distances of *one*, *two*, or *three* Revolutions of *Jupiter*, and sometimes found very *remarkable* Differences in the Motions of the *three inferior Satellites*; especially in the *Second*, or that next but one to *Jupiter*.

He doubts whether these *Inequalities* do not partly arise from the Eccentricities of the Orbits, and the Motion of their *Apsids*. And, by what he can collect from the Motions of the *Second Satellite*, he thinks it probable that the said *Inequalities* may proceed from the *mutual Action* of the Satellites on one another. Sometimes *(he says)* the Motion of the *Second Satellite* varies *so much*, in so small a Time, from its *mean* Quantity, that a small Eccentricity will not account for it; while the Rest of the Observations will not admit of a large Eccentricity — He finds that the *Period* of these *Errors* nearly answers to the Time the *three inferior Satellites* take up in returning to the same Situation, in respect of each other, and to the *Axis* of *Jupiter*'s Shadow; which *Period* is performed in 437 Days, or in 123 Revolutions of the *Second Satellite*.

After which Period, our judicious Author says, that the like Errors return nearly in the same Order. But, in the intermediate Time, after 60 Revolutions, this *Second Satellite* will deviate 10, 20, 30, and sometimes 40 *Minutes of Time* from its common Rate of Motion, during the 7 foregoing, or 7 following Months. That, because the *Satellites of Jupiter* are not found in the same Place in the Heavens after the Completion of the aforesaid *Period*, it is possible *(and probable)* these Errors may vary somewhat on that Account. That if the Orbit of this *Second Satellite* be likewise eccentric, as late Observations persuade that it is, the *Inequalities* arising from both Causes must be very intricate, and not easily to be distinguished by Observation only.

The *Errors* of the *1st and 3d Satellite* are not so great as those of the *2d*, but appear to arise from the same Causes with those *Errors*: not wholly depending on the *Eccentricity*.

Our judicious Author has likewise observed a sensible Difference between the Durations of the *Eclipses* of the *1st Satellite* made at the different *Nodes*, which *(he says)* were *longer* and *shorter* alternately. That is, the Durations of the Eclipses of the *1st Satellite*, at the descending *Node*, in *Leo*, in the Years 1682-3, 1694-5, and 1718, were, at least 2h 20m; whereas, at the ascending *Node*, in *Aquarius*, in the Years 1677, 1689, the Length of those Eclipses, of the *1st Satellite*, did not exceed 2h 14m; which was confirmed by comparing together as many Observations of such *Immersions* and *Emersions*, as could be procured, and such as were near together. Hence it is manifest, this *Difference* of Length of Time in the Eclipses of the *1st Satellite*, did not *wholly* arise from the *Eccentricity* of the Orbit, if it has any; but to what other Cause it may be assigned Dr. *Bradley* pretends not to determine.

*** *And hence we may observe, how precarious or uncertain is the Method of determining the Long. of Places from the* Eclipses of ♃'s Satellites.

Dr. *Bradley*, however, wishes, till we can get *more Light* in this Matter from future Observations, that some great *Geometer*, (such as the celebrated PROFESSOR, Mr. T. SIMPSON) in Imitation of the GREAT NEWTON, would apply himself to *investigate* these Irregularities, or *Inequalities*, from the certain and demonstrative Principles of *Gravity*: which, however, we will suppose, depend on physical Causes and Hypotheses, as well as on the *Mean of a Number of Operations*; in which we are the more confirmed, by the *celebrated Author* of the late *miscellaneous Tracts*.

From the Observations of the *4th Satellite*, its Orbit is confirmed to be *elliptical*: And all Dr. *Bradley*'s late Observations of the Motion of that *Satellite* will be correctly represented by supposing the greatest Equation of that *Satellite* equal to that of the Planet *Venus*, 48′: That its higher *Apsis* was in ♓ 8° 0′ at the Beginning of the *Year* 1717. Though by comparing this *Hypothesis* with the *older* Observations of the Years 1671, 1676, and 1677, the Computations were found to differ greatly from the Observations; yet putting back the *Apsis* to ♒ 14° 0′, at the Beginning of the *Year* 1677, those Differences *mostly* vanished. Allowing therefore an *equable* Motion to this *4th Satellite* of *Jupiter*, of 10 forward in *ten* Years, the *Hypothesis* aforesaid was found to agree with the *intermediate* Observations. The Numbers on that Principle, were found every where to agree with the Heavens (excepting only two Observations, both justly to be suspected) within 10′ of a Degree.

As to the *Latitudes* of the *Satellites* of *Jupiter*, it was found, from Observations, that the Nodes of the *4th Satellite* were, in the Year 1718, in ♒ and ☊ 11° $\frac{1}{2}$, the *Nodes* of the *3d Satellite*, lying then very near them. The *same Places* are therefore assigned by Dr. *Bradley*, to the *Nodes* of the two inferior *Satellites*, as Observation has not yet discovered any Thing to the contrary. Who takes Notice that if the *Nodes* of the Satellites were, 40 Years before that Time, in ♒ and ☊ 15°, according to *Cassini*. (whose Authority is of great Weight) that they will appear to have gone back about 1° in each of *Jupiter*'s Revolutions, by which the present Place of their Nodes may be nearly assigned.

Cassini's Inclination of the Orbits of the 3 *inferior Satellites* to the Plane of *Jupiter*'s Orbit being 2° 55′, is still retained; but the Inclination of the Orbit of the *4th Satellite*, 2° 42′, Dr. *Bradley* has considered somewhat less than *Cassini*'s. And as it is a very difficult Matter to determine, with *Accuracy*, the Situation of Circles so extremely small, so Dr. *Bradley* is of Opinion that it ought not to be undertaken but with most *excellent Telescopes*. Mr. *Short*, an excellent *Optician* in the *Strand*, we hear is a Competitor for this *Honour*.

ELEMENTS of the PLANETS PLACES and MOTIONS, according to our late IMPROVEMENTS. In REVOLUTIONS, SIGNS and DECIMALS.

The Mean PLACES and MOTIONS of the Five SATELLITES of SATURN.

RADICAL YEARS.	Mean Place 1, from Equinox.	Mean Place 2, from Equinox.	Mean Place 3, from Equinox.	Mean Place 4, from Equinox.	Mean Place 5, from Equinox.
Jan. 1. 1600 O. S. Jan. 1. 1600 N. S.	2s 12° 45′ 10 25 47	3s 28° 55′ 8 3 34	5s 13° 15′ 2 26 21	8s 7° 11′ 0 21 25	0s 25° 45′ 11 10 22
Jan. 1. 1700 O. S. Jan. 0. 1700 N. S.	0s 18° 56′ 2 21 16	7s 14° 38′ 7 7 45	8s 10° 38′ 3 4 2	3s 23° 28′ 7 15 7	6s 5° 1′ 4 15 5
TIME forward.	Mean Motion 1.	Mean Motion 2.	Mean Motion 3,	Mean Motion 4.	Mean Motion 5.
100 Julian Years.	19347r 10s 6° 11′	13345r 3s 15° 44′	8085r 2s 27° 24′	2290r 7s 16° 17′	460r 5s 9° 15′
4 Julian Years.	773r 10s 29° 2′ 50″ 24‴ +9286s.968244444	533r 9s 22° 13′ 45″ 36‴ +6405s.74097777	323r 4s 27° 29′ 45″ 36‴ +3880s.916533333	91r 7s 15° 3′ 4″ +1099s.5017037037	18r 5s 0° 22′ 12″ +221s.0123333333
365 Days	+193r 4s 1529152786	133r 4s.339121758	+80r 9s.565047684	22r 10s.687283950	4r 7s.215264658
Common Years 1. 2. 3. After Biffextile.	+4s 4° 35′ 14″ 51‴ +8 9 10 29 42 +0 13 45 44 53	+4s 10° 10′ 25″ 9‴ +8 20 20 50 18 +1 0 31 15 27	+9s 16° 57′ 5″ 9‴ +7 3 54 10 18 +4 20 51 15 27	+10s 20° 37′ 6″ 40‴ + 9 11 14 13 20 + 8 1 51 20 0	+7s 6° 27′ 28″ 35‴ +2 12 54 57 10 +9 19 22 25 45
Day	+6s.3565833295 6s 10° 41′ 51″	+4s.384490744 4s 11° 32′ 5″	+2s.656342596 2s 19° 41′ 25″	+,752567901 22° 34′ 37″ 20‴	+,151274697 4° 32′ 17″ 40‴
Hour	+,264857638 7° 56′ 44″ 37‴ &c.	+,182687114 5° 28′ 50″ 12‴ &c.	+,110680941 3° 19′ 13″ 32‴ &c.	+,031356996 56′ 26″ 33‴ &c.	+,0063031123 11′ 20″ 44‴ &c.
Minute	+,0044142939 7′ 56″ 44‴ &c.	+,003044785 5′ 28″ 50‴ &c.	+,0018446823 3′ 19″ 13‴ &c.	+,0005226166 56″ 26‴ 33iv &c.	+,00010505187 11″ 20‴ 44iv &c.
Second	+,0000735715 7″ 56‴ 44iv &c.	+,000050746 5″ 28‴ 50iv &c.	+,0000307447 3″ 19‴ 13iv &c.	+,0000087102 56‴ 26iv 33v &c.	+,00000175086 11‴ 20iv 44v &c.
Time of a Revolution of ♄'s Satellites.	12s 1d.8878066058 1d 21h 18m 26s 29th 26fo 40fi	12s 2d.7369199068 2d 17h 41m 9s 52th 47fo 48fi	12s 4d.5174895799 4d 12h 25m 11s 5th 48fo 55fi	12s 15d.9454050329 15d 22h 41m 22s 59th 41fo 26fi	12s 79d.3258898076 79d 7h 49m 16s 52th 45fo 45fi

The Mean MOTIONS of the Five SATELLITES of SATURN, *deduced* from the *Periodic Times*, as given, and not *computed* from the Motion, *(De Tabulis Satellitum Saturni Kkkk 3*, Halley's *Astronomical Tables)* SHEWING the *Difference* from the *True Motion* and *Times of Revolutions* deduced from that Motion, *above*—Hence the correct Revolutions (as above) should be always *deduced* from the Motion, for a Length of Time, and not the Motion from the Revolutions, in a limited short Time, as Below.

TIME forward.	Mean Motion 1.	Mean Motion 2.	Mean Motion 3.	Mean Motion 4.	Mean Motion 5.
100 Julian Years.	19347r 9s 14° 26′ 12″	13344r 7s 9° 30′ 21″	8085r 2s 20° 41′ 10″	2290r 7s 22° 51′ 32″	460r 5s 12° 33′ 38″
4 Julian Years.	773r 10s 28° 10′ 39″ +773r 10s 939248468	533r 9s 12° 22′ 48″ +533r 9s 4126745472	323r 4s 27° 13′ 38″ +323r 4s.907581626	91r 7s 15° 18′ 51″ +91r 7s.5104785992	18r 5s 0° 30′ 8″ +18r 5s.0167473551
365 Days.	193r 4s.145671236	+133r 4s.257102127	+80r 9s.5628112884	+22r 10s 6894761725	+4r 7s.2103674084
Com. Years. 1. 2. 3. After Biffextile.	+4s 4° 22′ 12″ +8 8 44 24 +0 13 6 36	+ 4s 7° 42′ 47″ + 8 15 25 34 + 0 23 8 21	+ 9s 16° 53′ 3″ + 7 3 46 6 + 4 20 39 9	+10s 20° 41′ 3″ + 9 11 22 6 + 8 2 3 9	+ 7s 6° 29′ 27″ + 2 12 58 55 + 9 19 28 22
Day	+6s.356563482 6s 10° 41′ 48″ 51‴ &c.	+4s.3842660354 4s 11° 31′ 40″ &c.	+2s.656336473 2s 19° 41′ 24″ 20‴ &c.	Sign. +,7525739093 +22° 34′ 37″ 58‴ &c.	Sign. +,1512777216 4° 32′ 17″ 59‴
Hour	Sign. +,264856811 7° 56′ 44″ 32‴ &c.	Sign. +,182677751 5° 28′ 49″ 11‴ &c.	Sign. +,110680686 3° 19′ 13″ 30‴ &c.	+,031357246 56′ 26″ 34‴ &c.	+,0063032384 11′ 20″ 44‴ &c.
Minute	+,00441428 7′ 56″ 44‴	+,003044629 5′ 28″ 49‴	+,001844678 3′ 19″ 13‴ &c.	+,0005226207 56″ 26‴ 34iv &c.	+,0001050539 11″ 20‴ 44iv &c.
Second	+,00007357 7″ 56‴ 44iv &c.	+,0000507438 5″ 28‴ 49iv	+,000030744 3″ 19‴ 13iv &c.	+,00000871034 56‴ 26iv 34v	+,0000017509 11‴ 20iv
Time of a Revolution.	12 Signs. 1d 21h 18m 27″ = 1d.8878125	12 Signs. 2d 17h 41m 22s = 2Ds.737060185	12 Signs. 4d 12h 25m 12s = 4Ds.5175	12 Signs. 15d 22h 41m 12s = 15Ds.945277777	12 Signs. 79d 7h 47m 0s = 79Ds.3243055555

Of JUPITER'S SATELLITES.				Of SATURN'S SATELLITES.			
Rad. ♃'s Orbit to Rad. Sats. Orb.		Revolution ♃ to Revolution Sats.	Velocities of Sats. to Velocity ♃.	Rad. ♄ Orb. to Rad. Sats. Orb.		Revolution ♄ to Revolution Sats.	Velocities of Sats. to Velocity ♄.
1	1964 to 1	2449 to 1	2449 to 1964	1	2905 to 1	5702 to 1	5702 to 2905
2	1236 to 1	1220 to 1	1220 to 1236	2	2292 to 1	3932 to 1	3932 to 2292
3	778 to 1	606 to 1	606 to 778	3	1719 to 1	2382 to 1	2382 to 1719
4	443 to 1	260 to 1	260 to 443	4	717 to 1	675 to 1	675 to 717
☽	275 to 1	12½ to 1	12⅓ to 275	5	238 to 1	135 to 1	135 to 238

De la Caille. See further on.

OF SATURN's FIVE SATELLITES.

THE fixed Stars *being at Rest, the periodic Times of the* Circum-Saturnial SATELLITES, *or* MOONS (*describing Areas round* Saturn *proportional to the Times of Description*) *are in the* Sesquiplicate (*or* $1\frac{1}{2}=\frac{3}{2}$ *Power*) *Proportion of their mean Distances from the Center of* Saturn.

AUTHORITIES.	1	2	3	4	5
	Periodic Times of the Satellites of Saturn.				
	d h m s	d h m s	d h m s	d h m s	d h m s
According to Sir *Isaac Newton*	1 21 18 27	2 17 41 22	4 12 25 12	15 22 41 14	79 7 48 0
To *Cassini* and *Halley*	1 21 18 27	2 17 41 22	4 12 25 12	15 22 41 12	79 7 47 0
	Distances of *Saturn*'s Satellites from his Center.				
According to Sir *Isaac Newton*	$1\frac{19}{20}$ Rad. Ring	$2\frac{1}{2}$, Rad. Ring	$3\frac{1}{2}$, Rad. Ring	8 Rad. Ring	24 Rad. Ring
To periodic Times	1,93	2,47	3,45	8	23,35
From Mr. *Huygen*'s Telescope, recited by Sir *If. Newton*. Prin. B. 3. } Recited also by Dr. *Halley*. See his *Tables*. }	2,097	2,686	3,752	8,698	25,348
	4,893 Rad. ♄	6,268 Rad. ♄	8,754 Rad. ♄	20,295 Rad. ♄	59,154 Rad. ♄

REMARKS.

The first of the foregoing Motions, are esteemed *the last* Improvements, preferable to those in *Philos. Transact.* N. 356, and sufficient for determining the Places of the *Satellites* of *Saturn*, in Respect of that Primary. From whence a more perfect Theory, by future and diligent Observations of the Motions of these Satellites, can only be expected.

N. B. The Forces tending to the Center of Saturn *are reciprocally in the duplicate* (or Square) *Proportion of the Distances. And the Cubes of the Distances of the Satellites, from the Center of* Saturn, *as the Squares of the periodic Times.*

The celebrated Mr. *Pound* found the *Ratio* of the *Fourth*, or *Huygenian Satellite*, (the biggest of all the 5) to the Diam. of *Saturn*'s *Ring*, as 374 to 43, or as 8,7 to 1 *nearly*. And likewise found the *Ratio* of the Diameter of the Ring to the Diameter of ♄, to be as 7 to 3: whence, by the foregoing *Proposition*, the Distances above are computed from the Distance and *Period* of the Fourth Satellite, as discovered by Mr. *Pound*, by Means of the Royal Society's Telescope of 123 Feet long, fitted with a curious *Micrometer*.

Anno 1719, *May* 29[d] 10[h] Julian Style, Mr. *Pound* observed, with the same Instrument, its greatest easterly Digression, 3′ 7″ from the Center of *Saturn*, whose Place was then ♏ 7° 41′. From whence, by Computation, the *Ratio* of the Dist. of this 4th *Satellite* from *Saturn* is to the Dist. of the *Sun from the Earth*, as 8,25 to 1000; whence the Distances of the other *Satellites* may be estimated.

The Diam. of *Saturn*'s *Ring* by the same Telescope was found (at the Time aforesaid) to be 43″, consequently, when ♄ is at his mean Dist. fr ⊖ is 42″, and Diam. of ♄ 18″. These Appearances are in very long and excellent Telescopes, because in such Telescopes, the apparent Magnitudes of the heavenly Bodies bear a greater Proportion to the Dilatation of Light, in the Extremities of those Bodies, than in shorter Telescopes. If all the *spurious* Light be rejected, the apparent Diameter of *Saturn* will not amount to more than 16″. *Cassini* supposed the four inferior Satellites to move in the *Plane of the Ring*, or that their Orbits are inclined to the Plane of *Saturn*'s Orbit, in an Angle of 30°. For *Saturn* being about the middle of *Gemini* and *Sagittarius*, the greater Axis of the *Ring* (then of the greatest Width) is found to be *nearly* double the Length of the *less* Axis; and these Satellites seem to describe *elliptic* Orbits, always similar to the *elliptic Ring*. In their greatest Digressions from *Saturn*, they are always found in the greater *Axis* of the Ring produced. These *Phenomena* could not happen unless the Orbits of the Satellites had nearly the same Situation with the Plane of his Ring.

The same excellent Astronomer since discovered that the 5th and outward Satellite is carried round *Saturn* in an Orbit very different from the Rest: For its ascending *Node* was found to be ♍ 5° 0′, and the *Inclination* to the Ecliptic an Angle of 18° only, or half of the *Inclination* of the former Satellites. Therefore, a Table of *Inclination* and *Reduction* is accommodated to the 5th Satellite, among our Tables further on.

The *famous* Astronomer, *Miraldus*, has (since the Discoveries of *Cassini*) by Means of the best Telescopes, and piercing Eyes, sought the *Nodes* of *Saturn*'s Ring (*See Mem. Roy. Acad. of Paris for* 1715 *and* 1716). He determines from subtil Observations, that the Plane of the said Ring, in the Year 1715, intersected the Plane of *Saturn*'s Orbit, in ♍ and ♓ 19° 45′; now, granting the Angle of Inclination of the said Ring to be 30°, the same Plane of the *Ring* intersected the Earth's Orbit, in ♍ and ♓ $16°\frac{1}{4}$, with an Inclination to the Plane of that Orbit in an Angle of 31° 20′. Therefore, at any given Time, to determine, *exactly*, the *Position*, *Species* and Points of the Apogee and Perigee, both of the Ellipses of the *Ring*, and of the Ellipses described by the *Satellites*, an oblique-angled *Spherical* Triangle must be resolved, as is shewn in our *Precepts* for computing the *Latitudes* of the Satellites of *Jupiter*.

The Earth's Latitude, in Respect of the Orbit of *Saturn*, scarcely ever exceeding 15′, it may (as this Affair is not sufficiently known) be neglected, as if *Saturn* and the Earth moved in the same Orbit. Therefore, from the *geocentric* Place of ♄, deduct 5[s] 19° 45′, and the *Remainder* will be the *Argument of Latitude*; with which, in the *Table of Latitude of the Satellites of Saturn*, 1, 2, 3, 4, take the *Inclination*, which is the *Angle* that a *visual Ray*, from the *Earth* to *Saturn*, is inclined to the *Satellite-Orbits*. The *Sine* of which *Angle* is to the *Radius*, as the *less Diameters* of these apparent Orbits are to the *greater*. Let the *Ellipsis* of the *Ring* be of the *same Species*: The *Apogean* Semicircle lies towards the *North*, when the Argument of Latitude is less than six Signs; but lies towards the *South*, when the Argument is greater.

A *Table of Reduction* is therefore added, (*hereafter*) requisite in so great an *Inclination* of the Planes of the Satellites, that we may know their true Apogee.

A General VIEW of the ELEMENTS of the THEORY of OUR PLANETARY SYSTEM.

According to Sir ISAAC NEWTON's Principles of Matter and Motion, and other *Authorities*.

Planetary BODIES.	Apparent Diameters *seen* at a mean Distance from ⊖.		Apparent Diameters *seen* at a mean Distance from ☉.		Tr. Diameters. ☉'s Parallax $10\frac{1}{2}''$.	*Revolutions* on their Axes, to same fixed ✱.	Periodical (rather Synodical) *Revolutions* through their Orbits, to the same fixed Star.		Squs. period. Tims. as Cubes M. Dists	*Inclination* of their Axes to Axis of Ecliptic.		*Inclination* of their Orbits to the Ecliptic.			Proportion of mean *Distances* fr. the *Sun*.	*Places* of their *Nodes* from Equinox 1760, Beginning N. S.			
Names.	′	″	′	″	Diam. ⊖		Days, Dec.	Y. D. H. M. S.		°	′	°	′	″	As	S.	°	′	″
SUN	32	12	. .	. .	91,7431	25° 12[h]	. . . .	. . . . . .		7	30	. .	. .	. .	0,00006	. .	. .	. .	. .
MERCURY	0	20	0	21	0,3670	unknown.	87,9692	0 87 23 15 39		unknown.		6	59	20	0,38710	♉	~~16~~	~~6~~	~~29~~
VENUS	1	20	0	30	1,0275	23[h] 20[m]	224,6176	0 224 14 49 20		75	0	2	23	5	0,72333	♊	14	28	49
EARTH	. .	. .	0	21	1,0000	23[h] 56[m]	365,2565	1 0 6 9 21		23	$28\frac{1}{2}$	0	0	0	1,00000	. .	. .	. .	. .
MOON	31	$16\frac{1}{2}$	0	6	0,2740	27[d] 7[h] 43[m]	27,3216	0 27 7 43 0		2	10	5 to + 18′			1,⁺⁄₋	♊	26	54	26
MARS	0	30	0	12	0,5229	24[h] 40[m]	686,9785	1 321 23 29 2		0	0	1	52	0	1,52369	♉	18	2	41
JUPITER	0	39	0	37	9,1468	9[h] 56[m]	4332,5140	11 315 12 20 9		0	0	1	20	0	5,20096	♋	8	24	9
SATURN	0	16	0	16	7,2661	unknown.	10759,2750	29 167 6 36 0		unknown.		2	33	30	9,54006	♋	21	23	2
	observed.							1st Year com.											

N. B. When the *Satellites* have *greater* Velocities than their *Primaries*, they must be *retrograde* in their inferior *Conjunction*, but direct in their superior. The Velocity of *Jupiter*'s second Satellite being nearly equal to that of its *Primary*, it must appear *stationary* in the inferior Conjunction. When the Velocity of the Primary is the greater, the *Satellite* appears *direct*. *See Bottom of the foregoing Table, and of Page* 128.

A Ge-

A General VIEW continued of the ELEMENTS of the THEORY of our Planetary System.

Bodies.	*Surfaces.*	*Magnitudes.*	Quantities of *Matter.*	Densities.	*Weight* on their *Surface.*	*Light* and *Heat,* on Surfaces.	*Ratio* of their *Polar* to *Equatorial* Diameters.	*Eccentricities* of their Orbits.	*Places* of their *Aphelia,* from Equinox, 1760, Begin. N. S.
	Newton.	*Newton.*	*Newton.*	*Newton.*	*Newton.*	*Newton.*	*Newton.*	*Halley.*	*Halley.*
	As sq. Diam.	As cub. Diam.	As	As	As	As	As	Sem. Transf. 1.	s ° ′ ″
Sun	8416,7963	772183.	169282.	0,25	22,9885	45025.		....	....
Mercury	0,1347	0,0494	unknown.	unknown.	unknown.	6,6737		0,20589	♐ 12 35 58
Venus	1,0557	1,0848	unknown.	unknown	unknown.	1,91146	19573000	0,0069813	♒ 7 27 56
Earth	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	—— Feet	0,01685 our	♐ 21 21 11
Moon	0,0751	0,0206	0,02513	1,2225	0,3333	1, ±	19658600	fr. ,066777 to ,043323	♏ 7 50 42
Mars	0,3780	0,1976	unknown.	unknown.	unknown.	0,43166		0,0926393	♍ 1 43 18
Jupiter	83,6639	765,2574	158,652	0,23625	2,16781	0,03696	.. 12 to 13	0,0482192	♎ 10 45 46
Saturn	52,7962	383,6124	56,0350	0,1675	1,21609	0,01098		0,05700322	♐ 29 53 18

Bodies.	Periodical *Revolutions.*	*Proportion* of mean Distances fr. ⊙.	Sq. Period Tims. as Cubes M. Dists.	Diameters.	*Magnitudes.*	Diameters in *English* Miles.	Mean *Distances* fr. the Sun, in *English* Miles.	Progressive *Velocities per* Minute in their *Orbs.*	Rotary *Velocities* of their *Equator* per Minute.
	Street.			11″ ⊙ Parx.					
	d h m s	*Street.*		*Keil.*	*Keil.*	*Whiston.*	*Whiston.*	Miles.	Miles.
Sun	.....	.....		.....	.....	763460	....	....	63.
Mercury	87 23 15 53	0,38710		0,3333	0,037	4240	32,000.000	1605	unknown.
Venus	224 16 49 24	0,72333		1.	1.	7906	59,000,000	1146	0,71
Earth	365 6 9 30	1,00000		1.	1.	7935	81,000,000	968	17,3
Moon		1. ±,003		0,2740	0,0205	2175	± 81,000,000	38	0,158
Mars	686 23 27 30	1,52369		0,5000	1,25	4444	123,000,000	779	9,26
Jupiter	4332 12 20 25	5,20110		15,0833	3431,5	81155	424,000,000	425	432.
Saturn	10759 6 36 26	9,53800		11,4166	1488.	67870	777,000,000	315	unknown.

Bodies.	Would descend to the Sun in	The projectile Forces being stopt, ☽ would descend to ⊖ in $4\frac{3}{4}$ Days.	Time of their Passage thro' Aphelion. Monsieur De la	*Aphelion* fr. 1 * ♈. Caille.	Periodical Revolns. to *s.
	Days.		Yr. Mo. d h m s	s ° ′ ″	d h m
Sun	....		....	......	....
Mercury	$15\frac{1}{2}$		1740 *Aug.* 9 6 27 40	7 13 54 30	87 23 $15\frac{1}{2}$
Venus	$39\frac{1}{2}$		1743 *Jan.* 23 15 24 10	9 7 49 20	224 16 $48\frac{1}{3}$
Earth	$64\frac{1}{2}$		1744 *Dec.* 29 2 51 40	8 8 42 45	365 6 $9\frac{1}{4}$
Moon	$64\frac{1}{2}$		....	......	....
Mars	121		1745 *Jan.* 12 8 31 40	4 1 49 50	686 23 $30\frac{1}{2}$
Jupiter	290		1744 *Apr.* 9 12 50 40	5 10 30 40	4332 12 0
Saturn	767		1723 *Sept.* 4 23 50 40	7 29 26 15	10759 8 0
			reduced to *Greenwich.*		

N. B. ☽ from ⊖ = 240,000 Eng. Miles at a mean Distance.

Lats ⊖.	M. Parx. ☽.	Gr. Parx. ☽.	M. Parx. ☽.	Least Par. ☽.	⊙ Alt. 31′ 38″
°	′ ″	61′ 7″	57′ 18″	53′ 29″	
0	57 20	Gr. Ap. Diam. ☽.	M. Ap. Diam. ☽.	Least Ap. Diam. ☽.	⊙ M. Dia. 32′ 11″ observed.
30	57 16				
38	57 14	33′ 37″	31′ 31″	29′ 25″	
45	57 12	Our Tables.			
52	57 10				
60	57 8	*Saturn*'s Ring; Diamrs. 9 to 4.			⊙ gr. Dia. 32′ 44″
90	57 4	♄ ♓♍ ♊♐	19°	Ring least most visible.	
	Newton.				

Secondaries, or Moons.

Greatest Eastern or Western Digressions of the Satellites of ♃.		
1	$5\frac{2}{3}$	Diameters. ♃.
2	9	
3	$14\frac{1}{3}$	
4	$25\frac{1}{3}$	
Monsieur *De la Caille.*		

Greatest Eastern or Western Digressions of the Satellites of ♄.		
1	$8\frac{5}{8}$	Diameters. ♄.
2	$11\frac{1}{3}$	
3	15	
4	36	
5	108	

Bodies.	Diameters.	Surfaces. *Conneissance des Temps.*	Magnitudes.	Distances from Sun. Greatest.	Least.	Revolutions on their *Axes.*	Periodical *Revolutions* through their Orbits to the same Point of the Ecliptic. 1st Com. Yr.
	Dis. ⊖.	D. ⊖ sq.	Ds ⊖ cub.	Sem. D. ⊖	Sem. D. ⊖		Yr. d h m s
Sun	100.	10000	1000000	....	....	25d 12h	....
Mercury	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{27}$	10274	6754	unkn.	0 87 23 14 34
Venus	1	1	1	16016	15796	23h 20m	0 224 16 41 30
Earth	1	1	1	22374	21626	23h 56m	1 0 5 48 54
Moon	$\frac{1}{4}$ +	$\frac{1}{13}$	$\frac{1}{50}$	62 fr. ⊖.	54 fr. ⊖.	27d 7h	0 27 7 43 5
Mars	$\frac{3}{5}$	$\frac{1}{3}$	$\frac{1}{5}$	36630	30426	24h 40m	1 321 22 18 19
Jupiter	10+	106	1170	119900	108900	9h 56m	11 313 8 35 4
Saturn	10—	99	980	221870	197802	unkn.	29 158 13 14 42
							our Tables.

Periodical Revolutions through their Orbits.

No.	*Jupiter*'s Satellites. d h m s	*Saturn*'s Satellites. d h m s
1	1 18 28 36	1 21 18 27
2	3 13 18 52	2 17 41 22
3	7 3 59 40	4 12 25 12
4	16 18 5 6	15 22 41 14
5	*De la Caille.*	19 7 48 0

Most of the above Differences of Proportions arise from the *Difference* of the *Sun*'s Parallax, taken $10\frac{1}{2}$, 11, $12\frac{1}{2}$, or more *Seconds* of a Degree, (under 15″) which will be truly determined, to a 500 Part of the whole, on *May* 26, 1761, when *Venus* will *transit* the *Sun's Disk.* The *Difference of Proportion* in the *Revolutions* of the same Bodies, their *Places* and *Points* of *Passage,* in Respect of Time, is owing to a greater or less *Accuracy* of Instruments, and also Diligence and Ability of the Observers. Much Improvement herein is expected from the accurate Observation of the Discoverer of the Aberration of Light, our present *Astronomer Royal,* Dr. *Bradley.*

*** Each *Satellite*'s Motion as seen from the Sun, being compounded of its own proper Motion, and that of its *Primary,* two Sorts of Revolutions must be distinguished among them; the one *periodical,* being the Time the Satellite takes in describing 360°, seen from the *Primary*'s Center; the other *Synodical,* being the Time the Satellite takes in returning to the same *Phase,* or Aspect, in Respect of the Sun. The *Synodical* therefore exceeds the *periodical* Revolution by the Time the Satellite spends in running over an Arc of its Orbit similar to that run over by the *Primary* in the Time of the Satellite's periodical Revolution.

A

A TABLE shewing, at *Sight*, the Number of Days, from the 1st of *January* to any *Month-Day* of the Year following in a common or *Leap Year*.

Com. Year. M.Ds	Leap Year. M.Ds	Jan. No Ds	Feb. No Ds	Mar. No Ds	Apr. No Ds	May No Ds	June No Ds	July No Ds	Aug. No Ds	Sept. No Ds	Oct. No Ds	Nov. No Ds	Dec. No Ds
1	0	1	32	60	91	121	152	182	213	244	274	305	335
2	1	2	33	61	92	122	153	183	214	245	275	306	336
3	2	3	34	62	93	123	154	184	215	246	276	307	337
4	3	4	35	63	94	124	155	185	216	247	277	308	338
5	4	5	36	64	95	125	156	186	217	248	278	309	339
6	5	6	37	65	96	126	157	187	218	249	279	310	340
7	6	7	38	66	97	127	158	188	219	250	280	311	341
8	7	8	39	67	98	128	159	189	220	251	281	312	342
9	8	9	40	68	99	129	160	190	221	252	282	313	343
10	9	10	41	69	100	130	161	191	222	253	283	314	344
11	10	11	42	70	101	131	162	192	223	254	284	315	345
12	11	12	43	71	102	132	163	193	224	255	285	316	346
13	12	13	44	72	103	133	164	194	225	256	286	317	347
14	13	14	45	73	104	134	165	195	226	257	287	318	348
15	14	15	46	74	105	135	166	196	227	258	288	319	349
16	15	16	47	75	106	136	167	197	228	259	289	320	350
17	16	17	48	76	107	137	168	198	229	260	290	321	351
18	17	18	49	77	108	138	169	199	230	261	291	322	352
19	18	19	50	78	109	139	170	200	231	262	292	323	353
20	19	20	51	79	110	140	171	201	232	263	293	324	354
21	20	21	52	80	111	141	172	202	233	264	294	325	355
22	21	22	53	81	112	142	173	203	234	265	295	326	356
23	22	23	54	82	113	143	174	204	235	266	296	327	357
24	23	24	55	83	114	144	175	205	236	267	297	328	358
25	24	25	56	84	115	145	176	206	237	268	298	329	359
26	25	26	57	85	116	146	177	207	238	269	299	330	360
27	26	27	58	86	117	147	178	208	239	270	300	331	361
28	27	28	59	87	118	148	179	209	240	271	301	332	362
29	28	29	60	88	119	149	180	210	241	272	302	333	363
30	29	30		89	120	150	181	211	242	273	303	334	364
31	30 31	31		90 91	121	151 152	182	212 213	243 244	274	304 305	335	365 366

EXAMPLE I.

To find the Number of Days from January 1, *to* October 31, *following, in a common and also* Leap-Year?

Against 31 in Month-Day Columns { in the common Year / in Leap-Year } Column you find under *Oct.* { Days. 304 / 305 } reqd.

EXAMPLE II.

To find the Number of Days from the 1st of January, *to the 23d of* February, *in a common or* Leap-Year?

Against 23 in the first Month-Day Column (serving for *January* and *February* in common and Leap-Years) you find under *February* 54 Days, for both Years, *required.*

N. B. The above Table is first made according to the common Year, or *First Column*, serving equally for *January* and *February* in common and Leap Years. And therefore a Day's Place advanced in *Second Column*, serves for Leap-Year, after *February* (of 29 Days) by adding a *Day* to that Month.

Hence, the Reason for our *adding* a Day's Motion to the *Epochas*, or Places, for the Beginning of Leap Years, to make them correspond with Places for *January* 1st, at Noon. For thus *contrived*, you see the Day's Motion ordered to be *added*, in *other Astronomical Tables*, for all Months after *February*, in Leap-Year, is already done in our *Epochas* for the Beginning of that Year, whilst there is only a *Day and Day's Motion to be taken out less for the* two *Months of* January *and* February, for each Leap-Year.

*** *In like Manner the Day's Difference between Old and New Stile do not take Place till* February *the 29th of the* Julian *Century.*

A TABLE for reducing *Julian* Years to *Days*, and the contrary.

Julian Years.	Days.	*Julian* Years.	Days.
* 1	365	600	219150
* 2	730	700	255675
* 3	1095	800	292200
4	1461	900	328725
8	2922	1000	365250
12	4383	2000	730500
16	5844	3000	1095750
20	7305	4000	1461000
24	8766	5000	1826250
28	10227	6000	2191500
32	11688		
36	13149		
40	14610		
44	16071		
48	17532		
52	18993		
56	20454		
60	21915		
64	23376		
68	24837		
72	26298		
76	27759		
80	29220		
84	30681		
88	32142		
92	33603		
96	35064		
100	36525		
200	73050		
300	100575		
400	146100		
500	182625		

N. B. There being 1461 Days in every 4 *Julian* Years, when either the 1st, 2d, or 3d [marked with *] is Bissextile, or Leap Year, one *Day* must be added to the Days in the Right-Hand Column, for the *true* Number of Days, in Succession from the 1st Year, as is evident by the 3 first Numbers set down, of 365 Days, in each Year.

Constr. After the 1st 3 Yrs, 1461 Days are added for each 4 Yrs, from the 1st 4 Yrs, *continually*, as far as 100 Yrs; then 36525 Days for 100 Yrs are continually added to the Days for the last hundred Years.

Arithmetically.

Multiply the No. of *Julian* Yrs by 365 Ds, and to the *Product* add the *Quotient* of those Yrs divided by 4, and the *Sum* will be the Ds in those Yrs, when the 4th from the 1st is a Leap-Year.

But if the 1st, 2d, or 3d is a Leap-Yr, then a Day must be added to the said Sum for the exact No. of Days required.

Ex. *To find the Number of Days in* 18 *Years, the famous* Eclipse-Period?

365 Ds
18 Years
2920
365
Product 6570
+4 = 18 ÷ 4
Sum 6574 Days required,
when 3d or 4th Yr. fr. 1st is a Leap-Yr.
but 6575 Days,
when 1st or 2d Yr. from 1st is Leap-Yr.

223 Lunations = 6585 Ds 7^h 43^m 20^s.

$$= \begin{cases} 18\text{Y}^s\ 11^d 7^h 43^m 20^s \\ 18 \quad 10 \quad 7 \quad 43 \quad 20 \end{cases} \begin{matrix} \text{Yrs. Reg.} \\ 3 \quad 4 \\ 1 \quad 2 \end{matrix} \text{ Lp-Yr.}$$

For 16 Yrs = 5844 Days
2 Yrs 730, +1
= 6574, and 6575
6585 . . 6585
11 10 Ds.

Julian

Julian Years.		Solar Years. our. EQUATION of Julian Years. $5^h48^m54^s46^{th}19^f$				Solar Years. *Mayer.* EQUATION of Julian Years. $5^h48^m51^s12^{th}Y^r.$				Gregorian Years. Equation of Julian Years.	Sydereal Years. EQUATION of Julian Years. $6^h\,9^m\,24^s\,26^{th}\,35^{fo}$				*Gregorian* greater and less than *Solar* Years. Our. + Gr. — less.				*Sydereal* greater and less than *Solar* Years. Our. $20^m\,29^s\,40^{th}\,16^{fo}$			
Years.	Days.	Days.	H	M	S	Days.	H	M	S	Days.	Days.	H	M	S	Days.	H	M	S	Days.	H	M	S
*1	365	+ . .	5	48	55	+ . .	5	48	51	. . . . .	+ . .	6	9	24	+ . .	5	48	55	+ . .	0	20	30
*2	730	+ . .	11	37	49	+ . .	11	37	42	Hundred	+ . .	12	18	49	+ . .	11	37	49	+ . .	0	41	0
*3	1095	+ . .	17	26	44	+ . .	17	26	34	Years	+ . .	18	28	13	+ . .	17	26	44	+ . .	1	1	29
4	1461	— . .	0	44	21	— . .	0	44	35	— ¼	+ . .	0	37	38	— . .	0	44	21	— . .	0	6	43
8	2922	— . .	1	28	42	— . .	1	29	10	of them,	+ . .	1	15	16	— . .	1	28	42	— . .	0	13	26
12	4383	— . .	2	13	3	— . .	2	13	46	= N°. of	+ . .	1	52	53	— . .	2	13	3	— . .	0	20	10
16	5844	— . .	2	57	24	— . .	2	58	21	Days new	+ . .	2	30	31	— . .	2	57	24	— . .	0	26	53
20	7305	— . .	3	41	44	— . .	3	42	56	is forward	+ . .	3	8	9	— . .	3	41	44	— . .	0	33	35
40	14610	— . .	7	23	29	— . .	7	25	52	of old	+ . .	6	16	18	— . .	7	23	29	— . .	1	7	11
60	21915	— . .	11	5	14	— . .	11	8	48	Style.	+ . .	9	24	27	— . .	11	5	14	— . .	1	40	47
80	29220	— . .	14	46	58	— . .	14	51	44	. . . . .	+ . .	12	32	35	— . .	14	46	58	— . .	2	14	23
100	36525	— 0	18	28	43	— 0	18	34	40	— 1	+ 0	15	40	44	+ . .	5	31	17	— . .	2	47	59
200	73050	— 1	12	57	26	— 1	13	9	20	— 2	+ 1	7	21	29	+ . .	11	2	34	— . .	5	35	57
300	109575	— 2	7	26	8	— 2	7	44	0	— 3	+ 1	23	2	13	+ . .	16	33	52	— . .	8	23	55
400	146100	— 3	1	54	51	— 3	2	18	40	— 3	+ 2	14	42	57	— . .	1	54	51	— . .	11	11	54
500	182625	— 3	20	23	34	— 3	20	53	20	— 4	+ 3	6	23	41	+ . .	3	36	26	— . .	13	59	53
600	219150	— 4	14	52	17	— 4	15	27	59	— 5	+ 3	22	4	26	+ . .	9	7	43	— . .	16	47	51
700	255675	— 5	9	21	0	— 5	10	2	39	— 6	+ 4	13	45	10	+ . .	14	39	0	— . .	19	35	50
800	292200	— 6	3	49	42	— 6	4	37	19	— 6	+ 5	5	25	54	— . .	3	49	42	— . .	22	23	48
900	328725	— 6	22	18	25	— 6	23	11	59	— 7	+ 5	21	6	39	+ . .	1	41	35	— 1	1	11	46
1000	365250	— 7	16	47	8	— 7	17	46	39	— 8	+ 0	12	47	23	+ . .	7	12	52	— 1	3	59	55
2000	730500	— 15	9	34	16	— 15	11	33	18	— 15	+ 13	1	34	46	— . .	9	34	16	— 2	7	59	30
3000	1095750	— 23	2	21	24	— 23	5	19	57	— 23	+ 19	14	22	9	— . .	2	21	24	— 3	11	59	15
4000	1461000	— 30	19	8	32	— 30	23	6	37	— 30	+ 26	3	9	32	— . .	19	8	32	— 4	15	59	0
5000	1826250	— 38	11	55	40	— 38	16	53	16	— 38	+ 32	15	56	55	— . .	11	55	14	— 5	19	59	5
6000	2191500	— 46	4	42	48	— 46	10	39	55	— 45	+ 39	4	44	18	— 1	4	42	48	— 6	23	58	30
7000	2556750	— 53	21	29	56	— 54	4	26	34	— 53	+ 45	17	31	41	— 0	21	29	56	— 8	3	58	11
8000	2922000	— 61	14	17	4	— 61	22	13	13	— 60	+ 52	6	19	5	— 1	14	17	4	— 9	7	57	59
9000	3287250	— 69	7	4	12	— 69	15	59	52	— 68	+ 58	19	6	28	— 1	7	4	12	— 10	11	57	44
10000	3652500	— 76	23	51	20	— 77	9	46	32	— 75	+ 65	7	53	51	— 1	23	51	20	— 11	15	57	29

* When 1, 2, or 3d Year is *Bissextile* 1 Day must be *added*.

Example.

To find the Number of Days in 673 Years Julian, and also same Number of Years Gregorian, 2d Year being Leap-Year?

Ju. Yrs	Ds
Agt. 600 . .	219150
60 . .	21915
12 . .	4383
1 . .	365
2d Yr. Biss. . . .	1
Y. Ju. 673 . .	245814
[illegible] . . . 1 —	Ds. reqd.
5 . . Dif.	— 5
Y. Gr. 673 . .	245809 Days reqd.

The above Equation to be applied to the Days of Julian Years in 2d Column, for the Days in the same Number of Solar Years.

Example.

To find the Number of Days in 673 Solar Years?

Yrs. Ju.	Days	Eqn.	d	h	m	s
Agt. 600 . .	219150 . .	—	4	14	52	17
60 . .	21915 . .	—	0	11	5	14
12 . .	4383 . .	—	0	2	13	3
1 . .	365 . .	+	0	5	48	55
2d Year Biss.	1 . .	—	1	0	0	0
Ys. Ju. 673 . .	245814 . .	—	5	22	21	39

— 5 22^h 21^m 39^s

Sol. Y. 673 . . 245808 1 38 21 Days required.

And the same Method for *Mayer*'s Equations.

N. B. The above Equations being made from the 2d Column of Days when 1st, 2d, or 3d Year is *Bissextile*, and 1 Day adds to Julian Years, and subtracts from Equations, you may find the Days to any Number of Solar Years from the Equations, as they stand for a Day less of Julian Years; amounting both Ways to the same.

The above Equations to be applied to Days of Julian Years, for Days of Gregorian Years.

N.B. When 1st, 2d, or 3d Hundred Year is Bissextile, a Day less must be subtracted.

The above Equations to be applied to the Days in Ju. Yrs for Ds in the same N° of Syderl Yrs.

Ex. *To find the Number of Days in 673 Sydereal Years.*

Yrs. Ju. Eq	d	h	m	s
Agt. 600 +	3	22	4	26
60 +	0	9	24	27
12 +	0	1	52	53
1 +	0	6	9	24
J. Y. 273 +	4	15	31	10
Ds. 245813		0	0	0

found before.

	Days	h	m	s
Dif.	245808	8	28	50

in 273 *Solar* Years, reqd.

N. B. The Equations — + shew how much the *Solar* and *Sydereal* Years respectively retreat or advance in the Month-days of the Yrs. *Julian:* Or — and + shew how much the Month-day by each Account is *forward* or *back* of the Month-day by the Julian Account.

Example.

To find the Difference between 250 Gregorian and Solar Years?

Y. Gr.		h	m	s
200	+	11	2	34
40	—	7	23	29
8	—	1	28	42
2	+	11	37	49
250	+	13	48	12

Ho. &c. more in 250 Years Gregorian than in as many Years Solar, required.

So for the Rest.

Example.

To find the Difference between 3400 Years Sydereal and Solar?

S. Yrs.	d	h	m	s
3000 —	3	11	59	15
400 —	0	11	11	54
3400 —	3	23	11	9

da. ho. &c. less in 3400 Sydereal than in as many Solar Years.

So for the Rest.

Of

Of the PRECESSION *of the* EQUINOXES.

SIR ISAAC NEWTON (Prop. 39. B. 3. of the *Principia*) by a Deduction from the Principles of *Gravity*, (contrary to the *Simpsonian* Hypothesis) demonstrates, that the *annual* Regress of the *Equinoxes*, would be 9″ 56‴ 50iv, at a mean Rate, in a *circular* Orbit, if the Plane of the *Equator*, and *Ecliptic* coincided. But, because they are inclined to one another in an Angle of about 23° 30′, this Recession of Motion must be diminished in the Proportion of the *Sine Complement* of 23°½ to *Radius*, or as 91706 to 100000, reducing it to 9″ 7‴ 20iv, which is the Annual Precession of the *Equinoxes* arising from the Action of the *Sun* only.

But, the Force of the *Moon* to move the *Sea* (and consequently *Equinoxes*) to that Force of the Sun is proved (*Prop.* 37. *B.* 3.) to be as 4,4815 to 1, whence 1 : 4,4815 :: 9″ 7‴ 20iv : 40″ 52‴ 52iv. The Precession of the *Equinoxes* from the Action of the Moon; and the Sum of this and the other Precession is 50″ 0‴ 12iv for the Mean annual *Precession* of the *Equinoxes*, by the joint Actions of the Moon and Sun on the Earth, to move the *Equinoxes*; supposing the Height of the Earth at the Equator to exceed the Height at the Poles by 17⅙ Miles only. If the Height of the Earth at the Equator exceeds the Height at the Poles by more than 17⅙ Miles, the terrestrial Matter will be more rare near the Surface, than at the Center of the Earth; and the *Precession* of the *Equinoxes* will be *increased* by the greater Excess of Height, and *diminished* by the greater Rarity of Matter.

Year		Long. *Pleiades.*				
In 294	before Christ	0s 27°	54′	0″	*Timocharis.*
1727	since Christ	1 26	10	58	See *Sherborne*, p. 12. *Wing*, [p. 56.
Yrs 2021	Distance.	0 28	16	58	Dif. Motion.

Whence 50″ 22‴ 48iv *Mean Annual Præcession.*

Year		Long. 1 ✱ *Aries*:			
In 1601	. . .	0s 27°	36′	50″	*Tycho Brahe.*
1700	. . .	0 28	59	20	*Flamsteed.*
Years 99	Distance.	1	22	30	Dif. Motion.

Whence, 50″ *exactly Mean Annual Præcession.*

But the celebrated Dr. *Bradley*, our *Astronomer Royal*, has, with great Diligence and Judgment, accurately determined the Quantity of this variable Precession through an intire Revolution of the Moon's Node, (performed in 18 Years, 11 Days, 7 Hours and 45 Minutes) on which its *Variation*, as well as *that* of the *Ecliptic Obliquity* depends: Being both at a Mean in 3s Longitude of the *Node*, and at their greatest and least Quantities in 0 and 6s Longitude thereof, respectively. *See Table, p.* 33.

The famous Mr. *Mayer*, of *Gottingen*, in his *Astronomical Tables*, determines from the *Paris* Observations, the mean Equinoctial *Præcession* to be 1° 24′ 20″ for 100 *Julian* Years, which is at the *Mean* Rate of 50″ 36‴ a Year. But from Dr. *Bradley*'s more accurate Observations we find it to be 1° 24′ 10″ only, in 100 *Julian* Years, or 50″ 30‴, a Year that the *Fixed Stars* go forward of the *Equinox*, at a Mean Rate, or which comes to the same Thing, that the *Equinox* recedes from the *Fixed Stars*, in those Times, respectively.

The *renowned T. Simpson* physically finds, on *antinewtonian* Principles, the Quantity of Precession (supposing uniform Density of the Earth) to be 21″ 7‴ by the Sun's Force only, (instead of 9″ 7‴ 20iv) which he artificially deducts from 50″, the Precession, from *Newtonian* Principles, by the Sun and Moon's Force, and so determines the Precession by the Moon's Force, to *bide* Mistake, explode *Newtonian*, and establish *Simpsonian* Reasoning. *See p.* 33. *Misc. Tracts.*

Of the PROGRESSION *of the* Aphelions *and* Nodes *of the Orbits of the Planets, in Respect of the* FIXED STARS, *and of the* Progression *of the* APHELION *of the* Earth's *Orbit.*

SIR ISAAC NEWTON (Prop. 14. B. 3.) proves (from Prop. 11. B. 1.) that the Aphelions of Planetary Orbits are immoveable, as are likewise the *Planes* of those Orbits, by *Prop.* 1, same Book, (That if the *Planes* are fixed, so must the *Nodes*) *except* so far as they may be disturbed and suffer some *Inequalities* by the mutual Actions of the *Planets* and *Comets*, in their Revolutions, upon one another: which, however, produce but small Motions and Inequalities.

That the *Fixed Stars* are immoveable, because they keep the same Positions to the *Aphelions* and *Nodes* of the Planets.

That since these Stars are liable to no sensible *Parallax*, from the annual Motion of the Earth; they can have no *Force* on our *System*; because of their *immense* Distances.

That, if they had any Effect upon the Bodies of our *System*, yet, by their being dispersed every where round the Heavens, their contrary Attractions would destroy their Mutual Actions, by *Prop.* 70. *B.* 1.

That, since the *Planets* near the SUN, (*Mercury*, *Venus*, the *Earth*, and *Mars*) are so small, that they cannot act but with little Force on each other, therefore their *Aphelions* and *Nodes* must remain fixed, *except* so far as they are disturbed by the Actions of *Jupiter*, (the greatest of all the Planets) *Saturn*, and the higher Bodies. Whence, we find, by the *Theory of Gravity*, that the *Aphelions* of the lower Planets move a little in *Consequentia*, or according to a following Order of Signs, in respect of the *Fixed Stars*.

That this Motion of the Aphelions of the Planets is in the *Sesquiplicate Ratio*, or one and half Power (betwixt the simple and duplicate *Ratios*) of their several Distances from the *Sun*.

That, if the *Aphelion* of *Mars*, in an 100 *Julian* Years, is carried 33′ 20″ forward in respect of the *Fixed Stars*, the Aphelions of the *Earth*, of *Venus*, and of *Mercury*, according to the said *Sesquiplicate* Proportion, will, in an 100 *Julian* Years, move forward 17′ 40″, 10′ 53″, and 4′ 16″, respectively.

Now, to	1°	24′	20″	*Mayer*'s Motion of the *Fixed Stars* beyond the Equinox,	in 100 *Julian* Years.
Add		17	40	Sir *Isaac Newton*'s Motion of the Earth's Apogee beyond them,	
Sum	1	42	0	Motion of the Earth's Apogee, beyond the *Equinox*,	
But, to	1°	24′	10″	Dr. *Bradley*'s Sydereal Motion, beyond the *Equinox*,	in 100 *Julian* Years.
Add		17	40	Sir *Isaac Newton*'s Apogeon *Progression* beyond the Stars,	
Sum	1	41	50	Motion of the ⊖ or ⊙'s Apogee beyond the Equinox,	
And, to	1°	23′	20″	Dr. *Halley*'s Motion of ✱s forward	in 100 *Julian* Years.
Add		17	40	Sir *Isaac Newton*'s Apogeon Progression beyond them,	
Sum	1	41	0	Motion of the ⊖ or ⊙'s Apogeon from Equinox,	
	1	41	7 20″	Dr. *Halley*'s Motion of Apogee for the same Time. *See his Tables.*	

But, as neither of these Quantities are found to agree with Observation, we have settled the mean Motion of ⊙'s Apogee at 1° 42′ 30″ from the *Equinox* in 100 Years; being 40″ more than by the *Theory of Gravity*, which Sir *Isaac* always refers to Observation, as the Proof of Theory, In the Time of *Hipparchus*, 140 Years before *Christ*, the Sun's *Apogee* was in 5° 30′ ♊, 1884 Years, since which Time in 1744, it has advanced 33° to the *Colures*, which is at the mean Rate of 1′ 3″ yearly; as the Intervals of some other Observations, loosely taken, ascertain. But a Mean being taken of the Quantities deduced from several remote Observations shews the Motion of the *Sun's Apogee* to be, as we have before determined it, 61″ 30‴, a Year: so small a Motion of the Earth's Aphelion, in respect of the Stars, distinguished from the *Precession* of the *Equinox*, being hard to determine by the *physical Laws* of Gravity only.

Of the Inequalities *of the* Earth's Motions, *caused by the* Gravitation *of the* Moon.

Whence are produced the Precession of the Equinoxes, Nutation, and different Motion of the Earth's Axis; and also Change of the Ecliptic Obliquity.

IF the Earth had no Moon, it would only be impressed with a *Central* Force towards the *Sun*. But being attended with a Moon, gravitating towards it, the Earth's Motion, round the Sun, is thereby changed and *accelerated* from the Moon's *Reaction*, when the Moon is retarded, and the contrary.

These *Inequalities*, in the Earth's Motion, are insensible, in respect of the Sun, whose *apparent* Motions are ever equal, and in contrary Direction to the *real* Motions of the Earth. The Moon's *Vicinity* to us is the Reason of these *Inequalities* being seen from the Earth. For, if the Moon went round the Sun at the *same Distance*, and in like Manner, as it goes about the Earth, the Inequalities seen from the Earth would then appear, at least, 275 Times less than they appear at present. And the Moon's *greatest Inequality*, 2° 41′, caused by her Combination of Gravity towards the *Sun* and *Earth*, would then appear not above 35″, very difficult to be observed. Besides, the Inequalities, caused by the ☽, in the ⊖'s Motion, cannot be near so considerable as the Inequalities of the Moon's Motion; because the Earth is about 50 Times bigger than the ☽; and therefore the Inequalities caused in the ⊖'s Motions, by the Gravitation of the Moon, will be almost *imperceptible* with regard to the Sun, and consequently the *reciprocal* Gravitations of the Earth and Moon, can no more affect the Computation of the *true Place of the Earth*, seen from the Sun, (or of the *Sun's true Place* seen from the Earth) than if the Earth had no ☽, or Satellite.

Nevertheless, The Moon's Gravitation towards the Earth, acting on the Earth's *Spheroidal* Figure, produce two very sensible Effects. The one the *ebbing* and *flowing of the Tide*; the other a *Variation of the Planes of the Ecliptic and Equator*: causing the Intersections of those Planes, and consequently *Points of the Equinoxes, to move retrograde.*

For, the Moon's Orbit being inclined about 5° 9′ to the Ecliptic, and its ascending ☊ making a Revolution in about 18 Years, through the Signs of the Ecliptic, it follows, that the Inclination of the Moon's Orbit is continually changing its Position with the *terrestrial Equator*. When the Moon's ascending ☊ *coincides* with the first Point of *Aries*, which is the ascending Node of the Equator, then the Inclination of the Moon's Orbit to the Plane of the Equator will be the *Sum* of $5°\frac{1}{6}$, and $23°\frac{1}{2} = 28°\frac{2}{3}$; but when the ascending Node meets with the first Point of *Libra*, or descending Node of the Equator, then the Moon's Orbit will be inclined to the Earth's Equator by only the *Difference* of $23°\frac{1}{2}$ and $5°\frac{1}{6} = 18\frac{1}{3}$. Therefore the Inclination of the Moon's Orbit to the Plane of the Ecliptic, increases, in about 9 Years, from $18°\frac{1}{3}$ to $28\frac{2}{3}$; and decreases from $28°\frac{2}{3}$ to $18\frac{1}{3}$ in about 9 Years, more; when a Revolution of the Moon's Node is compleated.

Were the Earth an *homogeneous Sphere*, its central Force towards the *Sun* and *Moon* would cause no Change in the Position of its *Axis*, on which it revolves: But its Figure being a *flatted* Sphere next its Poles (resembling a Spheroid generated by the Rotation of an Ellipsis on its less Axis) its Matter is raised or *accumulated* about the Equator, whereon the Sun and Moon acting obliquely, its *Equinoxes* are made to retrograde, and its Ecliptic Obliquity drawn to a nearer and nearer Coincidence with the Equator: besides having a periodical Variation with the Moon's Node.

For, suppose the Excess of the Spheroidal Matter, above the Spherical, to be collected about the Earth's Equator into a *Ring*, adhering to the Plane of the globular Earth, inscribed in the Spheroidal one, the two Points where this *Ring* intersects the Plane of the Ecliptic, or the two terrestrial *Nodes*, are the Points of *Aries* and *Libra*. Let all the *Particles* of Matter, of which the said *protuberant Ring* is composed, be considered as so many little Moons, (*See Newtonian Princip.* B. I. Prop. lxvi. Cor. 20.) revolving about the Earth in the same Space of Time as the Points of its Surface revolves, *viz.* in 23ʰ 56ᵐ 4ˢ; then the supposed *Ring* of Moons will be affected by 3 *Central* Forces of Gravity.

The 1st infinitely great in respect of the other two, is the Gravity towards the Earth's Center.

The 2d is their Gravitation towards the real Moon, in the Heavens.

The 3d their Gravitation towards the Sun, the weakest of the three Forces; the Sun being vastly farther from the Earth than the Earth is from the Moon.

By combining the 1st of these Forces with each of the other, it follows,

That the Nodes of the Ring *must always tend to move retrograde; and therefore the Line where the Planes of the terrestrial Equator and Ecliptic intersect, must also tend to move retrograde; causing a Precession of the* Points *of the Equinoxes.*

Now, because the Plane of the *Ecliptic*, wherein the Sun is situated, always makes an ∠ of about $23°\frac{1}{2}$ with the Plane of the Equator, it follows, that the Quantity of the *Precession of the Equinoxes*, resulting from the combined Gravitation of the aforesaid Ring, about the Earth, and its Gravitation towards the Sun, is apparently *equal* at each of the ⊖'s periodical Revolutions: Sir *Isaac Newton* making it 9″ 7‴ 20iv, arising from the Force of the Sun only.

But the Inclination of the ☽'s Orbit to the Plane of the Equator, being sometimes $18°\frac{1}{3}$, and at other Times $28°\frac{2}{3}$, the *Retrogradation* on the Nodes of the said Ring, or Precession of the Equinoxes, from the Ring's combined Gravity towards the Earth and Moon, must vary in Quantity: being greatest when the ∠ of Inclination is greatest, and the contrary. Hence, The *Precession of the Equinoxes*, from these two *Causes*, varies during a Period of about 18 Years; being greatest, or about 58″ in a Year, when the ☽'s ascending ☊ is in ♈, and least, or about 43″ in a Year, when her Node is in ♎. The mean Precession is about 50″ in a Year, when the Moon's Node is in ♋ or ♑.

Hence, it appears, that the *Inclination* of the said *Ring*, and consequently of the Plane of the Ecliptic to that of the Equator, must be subject to a *periodical Variation*: Their Variation from the Sun's Action being too small for Observation. But the Variations from the Moon's Action are apparent. For, the *Obliquity of the Ecliptic is observed to be sensibly greater, when the Moon's ascending* ☊ *is in* ♈, *and sensibly less when in the opposite Sign of* ♎.

Rules *for determining the* Quantity *of* Precession, Nutation, *and* Changes, *thereby, of* Declination, *and* Right Ascension, *in respect of the* Stars. *According to Table*, p. 33.

To find the present Equation of Precession?

As Rad. is to Sine ☊'s Distance from the *nearest* Equinoctial Point, *so is the greatest Equation of Precession to the* present Equation, *sought.*

To be added to the Mean Precession when the ascending ☊ ☽ is in any of the 6 Southern Signs, but to be subtracted therefrom, when in any of the 6 Northern Signs.

N. B. The Decrease of Inclination of the Equator to the Ecliptic, from the ☊ in the Beginning of ♈, is proportional to the versed Sine of the Node's present Distance, from ♈.

Whence, the said Inclination will be in its *mean Quantity* when the ☊ is in the *Solstice* of ♋ or ♑. *Consequently*, the Difference between the Mean and true Inclination will be, as the Difference between the versed Sine of the ☊'s present Distance from ♈, and the versed Sine of 90°. *That is*, As Cosine of Node's Distance from ♈. Therefore,

To

RULES *for determining the* QUANTITY *of* PRECESSION, NUTATION, *&c.*

To find the Nutation at any Time?
As Radius is to the Cosine of the Node's Distance from the nearest Equinoctial Point, so is the greatest Nutation (or Equation of Ecliptic Obliquity) to the present Nutation.
To *be added* to the *Mean* Obliquity of the Ecliptic when the Node is in any of the 6 ascending Signs ♑, ♒, ♓, ♈, ♉, ♊, but to be *subtracted* therefrom, when the Node is any of the 6 descending Signs ♋, ♌, ♍, ♎, ♏, ♐.

To find the Change *of a Star's* Declination *and* Right Ascension, *arising from the Nutation of the Earth's Axis?*
As Radius is to the Sine of the Star's Right Ascension, so is the Nutation (or given Change of the Equator's Inclination to the Ecliptic) *to the Change of the Star's Declination caused by that Nutation.* And, *As Cotang. of the Star's Declination is to the Cosine of its Right Ascension, so is the Nutation in the Table, to the Change of the Star's Right Ascension answerable.*

To find the Change *of the Star's* Declination *and* Right Ascension, *arising from the Precession of the Equinox?*
As Cosecant of Obliquity of the Ecliptic is to the Cosine of the Star's Right Ascension, so is the Precession of the Equinox (or Change of the Star's Longitude) *to the Change of the Star's Declination caused by Precession.* And, *As the Cosine of the Star's Declination is to the Cotang. of the Angle of Position, so is the Change of Declination* (found by the last Proportion) *to the Change of the Right Ascension, answerable.* Which *Changes* of Declination and Right Ascension are *additive* or *subtractive* according to the Nature of the Declination and Right Ascension, from which they vary.

N. B. When the Precession, in the second foregoing Case, amounts to some Minutes, the Mean Right Ascension must be used at the Middle of the Interval to make the Conclusion exact. For though the given Right Ascension of the Interval may be sufficient for the Purpose in common Cases, without the Trouble of a Computation for the middle Time, yet where the greatest Accuracy is required, the Operation must be repeated; *or the mean Result taken of a Number of Operations.* See Misc. Tracts.

☞ *A small Motion of Nutation and Precession* (see the said *Tracts*) *arises from the Moon's Declination. The greatest Quantity of which is to the greatest Quantity of* that *depending on the Sun, in a* Ratio *compounded of the* Ratio *of the Densities of the two Bodies,* that *of their periodic Times,* and that *of the Sines of the Inclination of their respective Orbits to the Plane of the Equator,* nearly; *amounting in no Circumstance to more than* ½ *of a Second.* And, there is another *Nutation* and *Precession* arising from more than all that have been considered by the same *celebrated Author*; *being the mean Result of a Number of Operations,* to be explained farther on.

OBLIQUITY *of the* ECLIPTIC.

To *determine the* Obliquity *of the* Ecliptic *with the* Equator, *from* Observation.
It is always equal to the Sun's greatest Declination, in either of the Tropics. Therefore,

RULE I. *The* Difference *taken between the Sun's* Meridian *Altitude, on either Day of the Solstice, and the Height of the cœlestial Equator at the Place of Observation, will be* nearly *equal to the Sun's greatest Declination, or Obliquity of the Ecliptic, required.*

RULE II. *The Sun's* Meridian *Altitude being taken, at each Tropic, or* Solstice, *the* Difference *of these* two *Altitudes will be correctly equal to the* Distance *of the two Tropics; the* half *of which Distance will be the true Distance of each Tropic from the Equator, correctly equal to the Ecliptic Obliquity,* required.

EXAMPLES.

	°	′	″
1st Observation. The Sun's Meridian Altitude at the Winter *Solstice*, 1743, observed at *Paris*	17°	40′	7″
By Page 2. Height of the cœlestial Equator, at *Paris*, (Lat. being 48° 50′ 10″)	41	9	50
Ecliptic Obliquity, *nearly*, The Difference	23	29	43
2d Observation. The Sun's Meridian Altitude, at the Summer *Solstice*, 1744, observed at *Paris*	64	37	17
Height of the Equator at *Paris*, as before	41	9	50
Ecliptic Obliquity, *nearly*, The Diff. . .	23	27	27
Former Diff. . .	23	29	43
Sum . .	46	57	10
Mean Ecliptic Obliquity, *correctly*. . . . . . Half . .	23	28	35
From the Mean of two Operations only.			

Or, 1st Meridian Altitude	17°	40′	7″
2d Meridian Altitude	64	37	17
Diff.	46	57	10
½. The Ecl^c. Oby.	23	28	35, *correctly*, as before.

N. B. *This Mean Quantity of the Ecliptic Obliquity is found to decrease less than* 1 *Min. of a Degree in a* Century, *besides having a* periodical *Variation of* 18″, *in a Revolution of the Moon's* ☊: *varying from its* greatest *Obliquity* 23° 28′ 39″, *the* ☽'s ☊ *being in* ♈, *to* 23° 28′ 21″, *its* Least, *the* ☊ *in* ♎; *and so by Rotation of the* Node's *Longitude, according to Table,* p. 33.

Of the MEASURE *of* TIME.

The Sydereal *and* Solar Day.

THE Rotation of the Earth, on its own *Axis* to the Left, or Easterly, being *uniform*, (causing an apparent uniform Revolution of the *fixed Stars*, about the Earth, to the Right, or Westerly) is the *equal Measure of Time.*

For, the Diameter of the Earth's Orbit being but a *Point* in Proportion to the immense Distance of the *fixed Stars*, their Position cannot be altered to us by any other Motion of the Earth than that of its Rotation on its own *Axis*, except a small *apparent Change* caused by the progressive Motion of Light, and of the Earth in its Orbit. And therefore the *real* Rotation Easterly of the same Point, or Meridian of the Earth, to the same fixed Point in the Heavens, (or the apparent Revolution, Westerly, of the same *fixed Star*, to the same Spot, or Meridian, of the Earth) through an entire Revolution, *is always the equal Measure of what is called the* Sydereal *Day.*

But, the Earth having an *accelerated* or *retarded* Motion, through its Orbit, to the Left, round the *Sun*, and a Rotation the same Way, or to the Left, on its *Axis*, causes an apparent Motion of the Sun to the *Right*. The *Interval* of these two Motions *(real or apparent)* at the Sun's next Return to the same Meridian, is what the *Astronomers call the Astronomical, or mean Solar Day,* which they make to begin and end at *Noon*. For if they reckoned it to begin and end from and to any other Time of the Day, (as from and to *Morning* or *Evening)* the *Inequalities of the solar Days would be much greater*, on Account of the *Increase* and *Decrease* of *artificial* Days. And the Sun being the *bigger Light*, and the Stars revolving in Succession through the Year, the solar Day, for that Reason, is found more convenient than the *sydereal*, for the *common Measure of Time.*

If the Sun had no other apparent Motion than that of its *diurnal* Revolution round the Earth, it would, every Day, appear to describe the same *Parallel*, through the Heavens, (from Rising to Setting) and be accompanied with the same *fixed Stars* at its Return to the same Meridian. But by the Earth's Progression in its Orbit, *as before described*, the Sun, every Day, appears to be removed as much to the Left, or Eastward, of the *Sun's Place* on the former Day, as the Earth has really moved the *same Way*, in the opposite Part of the Orbit or Ecliptic. And therefore, *apparently*, the Sun returns to the same Meridian each Day, about 59′ 8″ (the Earth's mean diurnal Motion in right Ascension) later than on the former Day, or Return of the same *fixed Star* to the same Meridian. For the Stars appear to advance, each Day, about 59′ 8″, (or $\frac{1}{365}$ Part of a Revolution) of the Sun.

Hence 1 mean astronomical or solar Day is measured by the *Sum* of 1 Revolution of the Earth on its *Axis*, and $\frac{1}{365}$ Part of another Revolution, $= 365° + 59' \, 8''$, OR

An ASTRONOMICAL *or* SOLAR DAY, at all Times,

Is accurately measured by the Sum of 360° *of the Equator, and an Arc of the Equator correspondent to the Arc of the elliptic Orbit, described by the Earth* (or Sun apparently) *in that Day*, i. e. 360° + *Diff.* R. A. *in that Day.*

For, when the Earth has described a Revolution of 360° to the *fixed Stars*, on its own *Axis*, it must still revolve to the *Left*, that Day, as much as its *annual* Departure in R. A. the *same Way* in its Orbit, to bring the Meridian of the Earth under the Sun; then *apparently* removed to the Left, or Eastward, as much as the Earth has advanced in the contrary Part of her elliptic Orbit.

The like is also evident by the apparent Motion of the Sun *and* Stars *exhibited on the cœlestial Globes.*

Therefore, if a *fixed Star* comes to the *Meridian* with the *Sun*, at Noon, the same *fixed Star*, after one Month or $\frac{1}{12}$ of a Year, will come to the same Meridian exactly $\frac{1}{12}$ of 24 Hours, or 2 Hours, *sooner*, and so, in Proportion, for any Number of Months after. In 6 Months, or Half a Year, it will come to the Meridian at *Midnight*, 12 Hours preceding the Sun; and in 365 Days, being almost a solar Year, it will come to the Meridian about one Day sooner, or nearly return to it *again* with the Sun; in which last *Interval*, the same *fixed Star* will have return'd to the Meridian about 366 Times, or made nearly that Number of Revolutions to 365 Returns to the Meridian, or Revolutions, of the Sun.

Hence, $\frac{365 \text{ Days}}{366 \text{ Rev}^s.} = 23^h \, 56^m \, 3^s \, 56^{th} \, 3^{fo} \, 56^{fi}$, &c. = Time of 1 Revolution of the *Earth* or *fixed Stars*; being nearly the Quantity of the *Sydereal Day*, in *mean* solar Time, but not correctly. See *Ferguson's Astronomy* (P. 95, 96) erroneously making 366 *Sydereal* Revolutions, exactly, in 365 solar Days.

☞ The *above Computation* does not consider the Earth's Motion (or Sun's apparently) through the whole Orbit, or Ecliptic in right Ascension; but only provides for 365 Days of a Revolution. Therefore the compleat Year must be divided by itself + 1, the Revolution gained in that Time, for the correcter Length of the *sydereal* Day.

Hence, $\frac{365.2423006021 \text{ Days.}}{366.2423006021 \text{ Rev}^s.} = ,9972695617$ Day $= 23^h \, 56^m \, 4^s \, 5^{th} \, 26^{fo}$, &c. correcter Time of the Sydereal Day.

Or,

MEASURE *of* TIME.

Or, As 365 Ds.243006021 : 360° passed over in R. A. :: 1 D. : 59'.1388236, &c.
Sun's mean diurnal Motion in R. A. = 59' 8'' 19''' 45iv, &c.

Now, As 360° + 59',1388236 = 360°.98564706 apparent diurnal Mot. ☉ : 24 Ho. } : 23h.9344696, &c.
:: 360° apparent diurnal Mot. ✳ . . . . }

The Sydereal Day, in mean *Solar* Time, as before, 23h 56m 4s 5th 26fo, &c.
Hence, any *fixed Star* comes to the Meridian each Night, sooner than on the former Night } by . . 3m 55s 54th 34fo [*Time by a regulated Clock.*

N. B. *As a Turn of the Earth on its Axis measures one sydereal Day, there must be* one Turn, *or sydereal Day* more, *in the Course of the Earth through her Orbit, than the Number of solar Days in which that Course is compleated, whatever Number those Days may be. And the same holds with respect to any other Planet revolving on its* Axis *to the Stars, and the Number of Days in which it goes through its Orbit.*

The Sydereal Day *deduced correctly.*

A *sydereal Year*, or Revolution of the Sun with the *same Star*, or ☉ à ✳, is not till 365 Ds .256532906 (because the Stars go forward 50'' 30''' a Year) consequently, the Number of sydereal *diurnal* Revolutions of that Star to the same Meridian, in that Time = 366.256532906.

$$\text{Whence, } \frac{365.256532906 \text{ Days.}}{366.256532906 \text{ Revs.}} = ,9972696733 \text{ Day.}$$

The Sydereal Day, in mean Solar Time, = 23h 56m 4s 5th 59fo 10fi, &c. *correctly.*
Hence, any *fixed Star* comes to the same Meridian each Night, sooner than on the former Night, correctly, } by . . . 4m 55s 54th 0fo 50fi, *Time by a regulated* [*Clock.*

⁂ *One apparent Revolution of the Sun to the Meridian will be lost by a* Planet *moving round him; in the same Manner that a Traveller would lose a Day going round the Earth the same Way with the apparent Motion of the Sun. Who would reckon* one Day *less at his Return than the Inhabitants remaining at the Place of his Setting out; whatever Number of Days, or Time, he took to go round the Earth.*

Hence, the Number of *solar* Days that any Planet takes to go round the Sun in its Orbit, will be always 1 less than the Number of *sydereal* Days, or Revolutions, of that Planet to the same fixed Star, in that Time. And if the Earth turned but once round its *Axis* in a Year, the *same Way* that it goes round the Sun in its Orbit, there would be *continual Day* on that Side of the Earth next the Sun at its Setting out, and *continual Night* on the opposite Side: As the Moon keeps the *same Face* towards us by turning once round her *Axis* while she goes once round the Earth.

The Table, Page 21, *is used for the Regulation of Clocks and Watches*, it shews the *Difference* in Succession, between a Number of *solar* and *sydereal* Days. The Difference between 1 *solar* and 1 *sydereal* Day is shewn to be 3m 55s 54th, as aforegoing, that the *fixed Stars* daily *accelerate*, or come to the Meridian sooner each Night than on the Night before.

To regulate a Clock *or* Watch.

If, through a small Hole, in a Window-Shutter, or in a Piece of Metal fixed to a Window, you observe at what Time any Star disappears or vanishes behind a *Chimney*, or Corner of a House, at a short Distance, and you further observe the same Star vanish or disappear the Night following 3 Minutes, 56 Seconds, sooner, by the Clock or Watch, and on the *Second* Night 7 Minutes, 52 Seconds, *sooner*; the Third Night 11 Minutes, 48 Seconds, *sooner*, and so on every Night, sooner, in that Proportion, for several Days, according to the *Table*, in Page 21. of *the Stars Acceleration*, then the *Clock* or *Watch* will be found to go true, *according to mean or uniform Time*. Otherwise, it must be altered to go by that *Rule*, and may be regulated by it to *half a Second of Time*.

The *Time-measurer* being thus well regulated according to the uniform Motion of the Earth on its Axis, or equal Measure of the *sydereal* Day, it will shew you the different *Inequality* of the *solar Day* from Noon to Noon; to be sometimes greater and sometimes less than 24 Hours by the Clock. The Time by a regulated Clock, and that by a true *Sun-Dial* will never be the same, except about *April* 15, *June* 16, *August* 31, and *December* 24, each Year. For, by the *equal Movement* of the Machine, all the Year, the unequal Time by the Sun will be found slower than the Time by the Clock, from *December* 24 to *April* 15; and, from thence, till *June* 16, faster; from thence to *August* 31, slower; and thence to *December* 24, faster than the Clock: The Sun's Time being the *unequal* Motion.

[*N. B.*

MEASURE of TIME.

N. B. The foregoing Days are those, on which the equal and unequal Movements *meet*, or shew the same Time; but are *not the Days, whereon the Sun's equal and true Motion is alike, for 24 Hours, hereafter shewn.*

The EQUATION-TABLES, at p. 19 and 20, exactly shew the *Difference between the Time by the Sun, and that by an equal moving Clock, for the Year.* Especially the Table at Page 19, giving that Equation readily from the *Sun's Place,* or Longitude only.

The Longitude *of the* fixed Stars *being known, when any Star, whose Relation to the Ecliptic is known, comes to the* Meridian *at Midnight, the Sun's Place, or Longitude, in the Ecliptic being then opposite to the Point of the Ecliptic coming to the Meridian, will be also known.*

EQUATION of TIME.

MEAN and TRUE DAYS.

TO measure Time by a *Clock* two Sorts of Time or Days must be necessarily distinguished.

The one *true* or *apparent*, known by the *Interval* between the *Instant* of the Sun's Center passing the Meridian, and that of its next Return to the same Meridian.

The other, a *mean Day*, or Time, known by the *Interval* from *one* Noon to the *next*, such as would be *daily* observed, if the Sun's Motion was *uniform* like that of the *Equator*.

Mean Time is shewn by well regulated Clocks; and *true Time* is deduced from Observations of the *Sun*.

The *true* and *mean* Day are each divided into 24 Hours, or 86400 Seconds of Time. The *Measure of the mean Day*, is the *Sum* of 360° of the Equator, and 59′ 8″, *annual* Motion in R. A. passing under the Meridian; which, divided by 86400, gives 15′ 28″. passing under the Meridian in each Second of Time.

The *Measure of the true Day* is the *Sum* of 360° of the Equator, and the Motion or Increase of right Ascension for that Day.

When the Sun is in *Apogee*, about *June* 30, Leap-Year, its Motion in R. A. in a Day, is about 1° 2′ 6″; therefore 361° 2′ 6″ is then the *Measure* of the true Day. Say, As 360° 59′ 8″ : 24^h *mean* Time :: 361° 2′ 6″ : $24^h\ 0^m\ 12^s$, *true* Time, corresponding; the *true* Day being then 12^s longer than the *mean* Day.

The *true and mean Day are of equal Length* when the Sun's Increase of R. A. is 59′ 8″ for a Day; happening about *February* 10, *May* 15, *July* 26, *November* 2. Leap-Year, N. S.

The above Days respect only the mean Length of the solar Days, when the mean and true Motion of the Sun, for 24 *Hours is alike, or the Clock (going sometimes before and sometimes after the Sun) marks nearly the same Difference of Time, or has no Increase for a Day; the Difference between the* Clock *and* Sun-Dial *at* 12, *being nearly the same as at all other Times of the Day. These Days are distinguished from the Days before observed, on which the Time marked by the Clock, going always equal, before and after the Sun, meet with Noon, or* 12, *marked by the Sun, moving unequally.*

The *Clock* and *Sun-Dial* on those Days (*April* 15, *June* 16, *August* 31, and *December* 24) go nearly together, or mark the same Time for 24 Hours. At other Times of the Year there is a considerable *Difference* between the true Noon, or Instant, of the Sun's Center passing the Meridian, and the mean Noon, or Instant, that the Sun's Center would have passed it, had its Motion in R. A. continued uniform, from any one of those last mentioned Days.

The *Differences* of each *mean* and corresponding *true* Day, successively, through the Year, from any one Day of the Year, accumulate insensibly; yet, at the End of many Days, form a considerable Variation between the Time of the Day, by the Clock, (going equally from the same Time of the Day or Noon by the Sun) and Time of the Day, by the *unequal* Motion of the Sun. This *Difference*, or *Equation*, from whatever *Epocha*, at Noon, or Time of the Day by the Sun, the mean Movement begins its Reckoning, is at all Times, successively, equal to the *Difference between the Sun's mean Place, and its true right Ascension, reduced to Time.* For the Sun's mean Place would be advanced as far in the *Equator*, as in the Ecliptic, by uniform Motion, and consequently the *Difference* between that Distance, and the true R. A. in the Equator, is the Arc of *Equation* between mean and true Time; being the very *Principle* on which the Difference between the mean and true Time depends. But if the Sun's mean Progress in R. A. or the Earth's Rotation on its Axis, be not uniform, this Equation of natural Days must be defective.

The aforesaid Arc of *Equation of Time* is reducible to two Arcs; one of which is the *Difference of the true Place of the Sun and its R. A.* and the other is the *Difference of the true and mean Place of the Sun*, and therefore the *Sum* or *Difference*, of which Arcs, converted into Time, will produce the Equation of Time, on its first Principles.

Tycho had a Suspicion of the Acceleration or Retardation of the Earth's Motion on its Axis, and was for ballancing the Part of the forementioned Equation of the Difference between the Sun's true and mean Place, (depending on the Sun's mean Anomaly) by only using the other Part of the Equation or Difference between the Sun's true Place and right Ascension, (depending on the ecliptic Obliquity) which he called the *Empyric*; because it served him to find by Calculation, the *Eclipses* he had observed.

Still

EQUATION *of* TIME.

Street imagined that this supposed *Inequality* of the Earth's Rotation, or first Mover, was compensated, by making Use of the Part of Equation neglected by *Tycho*, under a *contrary Title*, or Sign, as he has given it in his *Astronomia Carolina*; though we find no Reason for *any* Inequality of the Earth's Rotation.

Besides the *common Equation of Time*, giving the Hour by the Clock when it is Noon by the Sun, for each Day of the Year, there is annually published, (in an excellent *Ephemeris*, intitled the *Connoissance des Temps*, by *Monsieur Miraldi*, of *France*, sent for into *England* for Want of Astronomy being more encouraged among us) another Equation of *Clock-Time*, correspondent to the Increase of Time by the Sun. This *last Equation* begins its *Epocha* with the Time by the Sun, *November* 2, when the equal and true Motion of the Sun for a Day is alike: and not from the common *Epocha's*, of *April* 15, *June* 16, *August* 31, or *December* 24, when the Sun and Clock mark the same Time. It shews the Increase, or Difference, of *Clock-Time* from *November* 2, for each Day of the Year, correspondent to the Time by the Sun. The *Difference* of any two of which *Increases*, for any two Days of the Year, shews the Increase or Decrease of *Clock-Time*, correctly, correspondent to the Increase or Decrease of Time by the Sun in that Interval. This Equation is *exactly conformable to the other common Equation of Time, and its Increase and Decrease in the same Interval.*

EXAMPLE. *On* November 2, (the *Epocha* of the *increasing Clock-Time Equation*) *Noon by the Sun, according to the* common Equation of Time, *is at* $11^h\ 43^m\ 51^s$ *by a Clock, well regulated; and therefore this Clock being set at* 12, *on the same Day, when it is* 12 *or Noon by the Sun; it will continue to go* $16^m\ 9^s$ *forward of* correct *mean Time, each Day round the Year.*

Required the Increase of Clock-Time, correspondent to the Sun's Time, from November 12, (1st after Leap-Year) *to* December 10 *following, and the correct Times by a regulated Clock, when it is Noon by the Sun, on each of those Days?*

	Incr. of Clock-Time	Correct M. Noon.	
November 12	0′ 42″	$11^h\ 44^m\ 33^s$	By the *Connoissance des Temps.*
December 10	9 37	11 53 27	
Increase of Clock-Time in that *Interval* correspondent to Time by the Sun.	8 55 Dif. same as	8 54 Dif.	

But, *November* 12 . . . $12^h\ 0^m\ 42^s$ Noon by Clock, from above.
— 16 9 too fast.

11 44 33 correct *mean Noon*, by a regulated Clock.

December 10 . . . 12 9 37 Noon by the Clock, from above.
— 16 9 too fast.

11 53 28 correct *mean Noon*, by a regulated Clock.

So for the Rest.

☞ A Clock may be *regulated* by making it go from its Time of 12 by the Sun, with the Increase or Decrease of Time, in a Day, or for a longer Interval, according to the EQUATION-TABLES of *Time following, for each Day of the Year.*

The other Method of regulating a Clock, is by making it measure $23^h\ 56^m\ 4^s$ from the *Instant* of any Star' Passage through the Meridian, to its next Return to the same Meridian, as *before observed.* What its Return exceeds that Time it goes too fast, what it wants, it goes too slow, of *correct* mean Time.

To find the true Time, or Noon, by a regulated Clock or Watch?

RULE. Observe the *Time* marked by a *Clock*, when the Sun's Center is on the Meridian, being the *Instant* that the Sun ceases to rise any higher, and is going to descend. Or, you may observe the two *Times* marked by the regulated Clock, when the Sun has an equal Altitude in the Fore and After Noon; the *Middle* of which two *Instants* will be the true Noon marked by the Clock. Whatever the Time, marked by the Clock, is short of or exceeds, 12, at the true Noon, must be added to, or subtracted from, the Hours, Minutes and Seconds, marked by the Clock at all other Times of the Day, *for the apparent or true Time, by the Sun, required.*

EXAMPLE. *Let the Time of observing a given Altitude of the Sun, marked by the Clock, in the Forenoon, be* $9^h\ 20^m\ 34^s$, *and the Time of observing the same Altitude on the Afternoon be* $2^h\ 59^m\ 36^s$, *required, from theme, the Time marked by the Clock when it is* Noon, *by the Sun?*

Time 1st Observation	9^h	20^m	34^s —	
	12	0	0	
1st Observation	2	39	26	*before* 12.
Time, 2d Observation	2	59	36	*after* 12.
Sum	5	39	2	*Interval.*
½	2	49	31	+ Time 1st Observation. — fr. Time 2d Observation.
Hence, Noon by the *Sun*, is at	0	10	5	after 12 by the Clock.

Which Time must be subtracted from all other Hours of the Day by the Clock, for the Time *apparent* by the *Sun.*

EQUATION *of* TIME.

The *Instant* of the Paſſage of a *Star*, or Planet, over the *Meridian*, is determined by the like METHOD OF CORRESPONDING ALTITUDES. The farther the *Sun* or *Star* is from the Meridian, the *faſter* it aſcends or deſcends, and is therefore the fitter for Obſervation, if equal Altitudes can be obſerved.

This *Method* is of moſt uſe for obſerving the Stars, or Sun in his *Solſtices*, having no Change of Declination in the *Interval* of the two Obſervations. For, when the Sun has a Change of Declination, whereby it approaches the elevated Pole, and *increaſes* the Meridian Altitude with the *Length of Days*, and conſequently makes the Afternoon Arc greater than the Forenoon Arc, deſcribed between the ſame Altitudes, then the *Mean*, between the two obſerved Inſtants, will be *later* than it *really* happened. And the *contrary* follows in the *Decreaſe* of Days: For then the Change of the Sun's Declination being towards the depreſſed Pole, the *Mean* of the two obſerved *Inſtants* will be *ſooner* than it really was.

The greateſt Error in the true Time, thus computed, occaſioned by the Sun's Change of Declination, does not exceed 30ˢ. But, to compenſate for that Inaccuracy, we have given a *Table for the different Latitudes* and Intervals between the two Obſervations, exhibiting the *Mean Inſtant*, or *Noon* of the Sun, marked by the Clocks, as correctly as if no Change of the Sun's Declination ever happened. *See this Table farther on.*

Of the NATURE *and* DIVISION *of* TIME.

Time meaſured by Motion.

TIME is the *Succeſſion of Duration*, meaſured by the Motion, or Change of Place, of the *Celeſtial* Bodies, in their reſpective Revolutions through their Orbits; *particularly*, by the apparent Motion of the Sun, or the real Motion of the Earth in its Orbit. And the *Standard Meaſure* of Time to which all other Meaſure thereof refers by Compariſon, is the Mean *Solar Year* (ſubdivided into *Months*, *Weeks*, *Days*, *Hours*, *Minutes*, and *Seconds*) during one Revolution of the Earth (or Sun apparently) through its Orbit.

The *Mean Solar Day*, and its Parts, differ from the *variable* Solar Day (from Noon to Noon) and its Parts, as has been ſhewn before.

Mean Solar Year.

The *Mean* Solar Year is determined by dividing the Number of Days by the Number of the Revolutions apparent, or real, of the Sun or Earth, in that Time, as derived from the Sun's Mean Motion.

$$\text{Thus, } \frac{36525 \text{ Days in 100 Julian Years}}{\text{Rev}^{s}\ \ \text{Dec}^{s}\ \ 100{,}002108024 69, \text{ in 100 Julian Years}} = \overset{\text{D}^{s}.\ \ \text{Dec}^{s}.}{365{,}2423006021}, \text{ or } 365^{d}\ 5^{h}\ 48^{m}\ 54^{s}\ 46^{th}\ 19^{fo}\ 16^{fi}, \&c.$$

Length of the *Mean* Solar Year. *See p. 7.*

The Length of the Year between other *like Points* of the Ecliptic differs by many *Seconds* of Time *more* or *leſs*, according to the following Computations from Dr. *Halley's Tables*, *(See Palladium for 1756)* where the Equation of Time, and *Decreaſe* of the Sun's Mean Anomaly, for a Revolution to different Points of the Ecliptic are conſidered.

Variable Solar Year. Dr. *Halley*'s mean *Solar* Year, $365^{d}\ 5^{h}\ 48^{m}\ 55^{s}$ *nearly*, between the next *vernal* Equinoxes; nearly according to our Mean Year. ☉ enters

Sign	Month	Apparent Time. d	h	m	s	Eq. of m. Yʳ.	Dif. Length Year. Ds	h	m	s
♈	*March*	19ᵈ	15ʰ	54ᵐ	30ˢ	+ 0ˢ	365Dˢ	5ʰ	48ᵐ	55ˢ
♉	*April*	19	4	58	33	− 23	365	5	48	32
♊	*May*	20	5	55	7	− 49	365	5	48	6
♋	*June*	20	14	55	25	− 61	365	5	47	54
♌	*July*	22	1	54	9	− 58	365	5	47	57
♍	*Aug.*	22	8	12	43	− 41	365	5	48	14
♎	*Sept.*	22	4	25	34	− 16	365	5	48	39
♏	*Oct.*	22	12	1	17	+ 8	365	5	49	3
♐	*Nov.*	21	7	53	25	+ 9	365	5	49	4
♑	*Dec.*	20	19	57	56	+ 40	365	5	49	35
♒	*Jan.*	20	0	26	4	+ 38	365	5	49	33
♓	*Feb.*	18	15	17	10	+ 24	365	5	49	19

Since the Sun's *Entrance* into the *ſame* Sign to the *ſame* Sign again.

Mean Aſtronomical or Solar Year, called the Tropical Year.

N. B. Though the Length of the above *Mean Aſtronomical* Year is ſometimes determined by the Number of Revolutions betwixt a given Number of *Solſtices*, containing a certain Number of Days, on which account the *mean* Year is commonly called the *Tropical* Year; yet the Length of the Year ſo determined is properly the Diſtance of Time between the *next vernal Equinoxes*, or Mean Year, before aſcertained, *falſely diſtinguiſhed* by the Name of *Tropical*. For, according to the foregoing Computation, the *Tropical* Year of *Cancer* is ſeen to be leſs than the *Mean* Year, by 61 *Seconds* of Time; and the *Tropical* Year of *Capricorn* more by 40 *Seconds* of Time than the *Mean* Year; as the Year of the *Autumnal* Equinox is ſeen to be *leſs* than the Year of the *Vernal* Equinox, by about 16 *Seconds* of Time; owing to the progreſſive Motion of the Sun's *Apogee*, and regreſſive one (or Preceſſion) of the *Equinox*, in reſpect of the *fixed Stars*, each *Julian* Year; making together 1′ 1″ 50‴, in a *Julian* Year, that the Sun's *Apogee* goes forward of the *Equinox*.

Hence,

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Near Sydereal Year.

Hence, To $365^{d}\ 5^{h}\ 48^{m}\ 54^{s}\ 46^{th}$ the *Solar* Mean Year.
Add . . . . . $20\ \ 29\ \ 42\frac{1}{2}$, answering $50''\ 30'''$ Mot. ✱s in a Year *nearly*.

Sum, $365\ \ 6\ \ 9\ \ 24\ \ 28\frac{1}{2}$, the *Sydereal* Year, or Time in which the Sun returns to the same *Star*.

Near Anomalistical Year.

Again, To $365^{d}\ 5^{h}\ 48^{m}\ 54^{s}\ 46^{th}$, the *Mean* Year.
Add . . . . . $25\ \ 5\ \ 41$, answering to $61''\ 50'''$ nearly Mot. ☉ Apog. in a Mean Year.

Sum, $365\ \ 6\ \ 14\ \ 0\ \ 27$, the *Anomalistical* Year, *nearly*, or Time in which the Sun returns to the same *Anomaly*.

Correct Sydereal Year.

But *correctly*,
$12^{s}\ 0\ 0'\ 27''\ 19'''\ 12^{iv}$ exactly = ☉'s Mean Motion } in 1 *Julian* Year.
— $50\ \ 30\ \ 00$ = M Motion *Fixed Stars* }

As Dif. $11\ 29\ 59\ 36\ 49\ 12$: $365{,}25^{Ds}$ :: 12^{s} : $365{,}256532906^{Ds}$ = $365^{d}\ 6^{h}\ 9^{m}\ 24^{s}\ 26^{th}\ 35^{fo}\ 5^{fi}$ *fere*, the Length of the *Sydereal Year*, or Revolution ☉ à ✱.

$12\ \ 0\ \ 0\ \ 27\ \ 19\ \ 12$ ☉'s M. Motion. } in 1 *Julian* Year.
— $1\ \ 1\ \ 50\ \ 0$ M. Mot. ☉'s Apog. }

As Dif. $11\ 29\ 59\ 25\ 29\ 12$: $365{,}25^{Ds}$ :: 12^{s} : $365{,}259727107^{Ds}$, &c. = $365^{d}\ 6^{h}\ 14^{m}\ 0^{s}\ 25^{th}\ 19^{fo}\ 21^{fi}$ &c. the Length of the *Anomalistical Year*, *correctly*.

Correct Anomalistical Year.

N. B. *The above correct Proportions are new; there being no Instance, that we have seen, in any former Astronomy, where the Sydereal and Anomalistical Year are correctly deduced on their true Principles.*

The Time of a Mean *Lunar* Year is measured by *twelve Lunations*, or *Revolutions*, of the Moon to the Sun, from any *Synodical* Conjunction, to the next, of the *Moon* and *Sun*.

Now, a Mean *Lunation*, or one mean *Lunar* Month, is thus determined.

$13^{r}\ 4^{s}\ 12^{o}\ 40'\ 42''\ 15'''\ 0^{iv}$ = ☽'s M. Motion } in 1 *Julian* Year.
$12\ \ 0\ \ 0\ \ 27\ \ 19\ \ 12$ = ☉'s M. Motion }

As Dif. $12\ 4\ 12\ 40\ 14\ 55\ 48$: $365{,}25^{Ds}$ :: 12^{s} : $29{,}53059085119^{Ds}$, &c. = $29^{d}\ 12^{h}\ 44^{m}\ 3^{s}\ 2^{th}\ 48^{fo}\ 21^{fi}$ &c. a Mean *Lunar* Month, or Lunation.

Mean Lunar Year.

Twelve Times which = $354^{Ds}.36709021428$, or $354^{d}\ 8^{h}\ 48^{m}\ 36^{s}\ 35^{th}\ 40^{fo}\ 15^{fi}$ *fere*, the Length of the Mean *Lunar Year*.

The *civil* or *political* Year consist of a certain Number of Days, according to the Usage or Custom of any particular Nation; of which some reckon according to the Days in the *Lunar*, but most according to the Days in the *Solar Year*.

The *civil* Solar Year with us contains 365 Days for three Years together, and every *fourth* Year, commonly called *Leap-Year*, or *Bissextile*, contains 366 Days. This Account of Time, or reckoning, by the Year, is called the *Julian* Account, from *Julius Cæsar*, who first instituted it, as a Means to make the *civil* and *correct Solar* Year and its Seasons keep Pace together. He ordered, in each Leap-Year, the *Intercalary* Day, to be added to the 23d of *February*, and for the 23d and 24th of that Month to be reckoned as *one Day*, which 23d being the 6th of the *Calends* of *March*, and twice reckoned, called *Bis sextus Dies*, gave the Name of *Bissextile* to that Year. In our English Almanacs this *Intercalary* Day is added at the End of *February*, making the 29th Day of that Month, in each *Bissextile* or Leap-Year.

Hence, a *Mean Julian Year* consists of $365^{d}\ 6^{h}\ 0^{m}\ 0^{s}\ 0^{th}\ 0^{fo}\ 0^{fi}$
But a *Mean Solar Year* consists of $365\ \ 5\ \ 48\ \ 54\ \ 46\ \ 19\ \ 16$ &c.

Difference, a mean *Julian* Year is greater than a mean *Solar*, } . . . . $11^{m}\ 5^{s}\ 13^{th}\ 40^{fo}\ 44^{fi}$
Or, Time that the *Seasons* go back each *Julian* Year }

Hence, $\dfrac{1\ \text{Day}}{,0076993979} = 129{,}997178091^{\text{Yrs Decs}}$ &c. { Or, $365^{d},25$ *Julian Year.* $365{,}2423006021$ *Solar Year.* ——— $,0076993979$ Difference. }

Or, $129^{yrs}\ 23^{h}\ 55^{m}\ 56^{s}\ 11^{th}\ 13^{fo}\ 25^{fi}$ &c. or about 130 Years, in which the Seasons, or Equinoxes, fall back or happen *earlier* by 1 Day in the *Julian* Account.

This falling back of Seasons causing great Confusion in settling the Time of *Easter*, according to its original Institution, Pope *Gregory* XIII. took in Hand to reform the Calendar, in 1582; whose Example was followed in 1752, by the *British* Parliament.

In the Time of the *Nicene Council*, Anno Christi 325, the *Vernal* Equinox is said to have happened (but was rather erroneously determined) on the 21st of *March*: For, by *Halley's Astronomical Tables* it happened on *March* the 20th, $11^{h}\ 25^{m}$ in the Forenoon; which, among Astronomers, is on *March* the 19th $23^{h}\ 25^{m}$ P. M. and not on the 21st of *March*, according to *Error established*. Besides, we find the *Vernal Equinox*, according to *Halley*, fell on *March* the 19th, $15^{h}\ 54^{m}\ 30^{s}$ apparent Time, in the Year 1756 *(See Palladium for that Year)* which corresponds with

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k k
5.15 Oct
1582

March the 20th, 3^h 54^m 30^s, *Morning*; and fell about 44^m 21^s, later in 1752, that Year for which the *Old Stile* was corrected to correspond with the new one, or foreign Account of Time, and likewise adapted to the *Error of the Equinox, falling on the 21st, instead of on the 20th of March*, as it fell at the *Nicene Council*, and falls at this Time, though the Alteration of our Stile to correspond with the foreign Account was the principal View. Pope *Gregory* XIII. first settled the *New Stile* 1582, who called 5th *October* the 15th for that Year, thereby striking 10 Days out of the *Calendar*. For, dividing 1257 Years since the *Nicene Council*, by 130 Years, in which the Seasons fall back a Day, the *Quotient* will be above $9\frac{1}{2}$ Days, the Seasons were then fallen back. From hence, 1257 *Solar* Years, since the *Nicene Council* appear to have been compleated, besides $9\frac{1}{2}$ Days, in 1257 Years of the Julian Reckoning; for which Reason 10 Days lost in the solar Account of Time, were first struck out of the *Julian Calendar*, since made to correspond with solar Time.

Alteration of Style. And to prevent (as *much as possible*) the falling Back of the Seasons in the Month Days for the future, and to keep a Conformity between the *Gregorian* and *Solar* Account of Time, (the one in whole Days, and the other in Days and Parts, to the Year) Pope *Gregory* farther ordered, that every *Fourth Hundred Year*, from 1600, should consist of 366 Days, as *usual*; but that every *Three Hundred Years* or Centuries, in Succession from *even* Hundreds, should consist of 365 Days only (*similar to three successive Years after each Bissextile*) and not contain 366 Days each, as formerly. Thus he provided for 3 Days, that the Seasons fall back in every 400 (instead of 390) Years. *See p.* 30, 31.

In this NEW ACCOUNT of Time, called the GREGORIAN or NEW STILE, from Pope *Gregory* it's Author, the Seasons fall back but *one Day* in 5200 Years.

For, they fall back in 5200 Years by Julian Account $= \frac{5200}{130} = 40$ Days.

They go forward in 5200 Years, by the *Gregorian* Account $= \frac{5200}{400} \times 3 = 39$ —

Difference, they fall back in 5200 Years Gregorian Account . . . 1 Day.

Or, because in 400 *Gregorian Account*, but 1 Day of the Season's falling back in the Julian Account is considered, and provided for, which happens in 390 Years, 10 Years, in every 400 Gregorian, are unprovided for, in which the Seasons fall Back; and therefore $\frac{130}{10} = 13$, Times 400 Years $=$ 5200 Years *Gregorian*, as before, in which the Seasons fall back 1 *Day*.

	Anno Chr.
The Old *Stile* was corrected in *England* to the *New*, for . .	1752
The Year of the *Nicene Council*	325
Difference. The Years from *Nicene Council* to our Alteration of Stile . .	1427

Now, $\frac{1427}{130} = 11$ Days, nearly, the Seasons fall back from the Time of the *Nicene Council*, to 1752, the Time when the Stile was altered in *England*.

Which 11 Days lost in the solar Account of Time, were supplied in the *Gregorian* Account, in our Calendar, by calling the 3d of *September* 1752, *the 14th of* that Month. This Alteration of Style reduced the *Seasons* (*with regard to the Month Days*) as they stood at the Council of *Nice*: For 1427 *solar* Years and 11 Days over are *nearly compleated* in that Time instead of 1427 Years only, reckoned by the *Julian Account*.

Hence it appears, that *reducing* the same Number of Days into different Years of any Kind, does not give a different Value to those Years in either Account of the same Time; which is *contrary* to *common Opinion that* those Days are lost. For, whether we reckon the same Number of Shillings, in Guineas, at Twenty Shillings and Six Pence, or at 21 Shillings each Guinea, the *different* Number of Guineas by either Account, in the same Number of *Shilling Pieces*, will have but the same Value, similar to the same Number of Days in a different Number of Solar, *Julian*, and *Gregorian* Years.

Of YEARS.

Civil Year. The *civil* or common *Year*, is of different Length, according to the Custom among different Nations. Some Nations reckon this Year by the *Solar* and some by the *Lunar* Motion.

Solar. Lunar. The *Civil Year*, in most Parts of *Europe*, contains 365 Days for three Years successively, called common Years, and every 4th Year contains 366 Days, called Leap Year, or *Bissextile*.

These Civil Years are called also *Julian* Years, from *Julius Cæsar*, who added a Day every 4th Year to make (as he expected) the *Civil* and *Solar* Account of Time keep Pace together; and keep the Seasons, by that Means, *nearly* to the same Days of the Month.

Complete. Vacant. The *civil* or common *lunar Year* is likewise *Complete*, or Vacant. The *Complete* consists of 354 Days, at the End of which the Year begins again. The *Vacant*, or *Embolimic* Year, is that wherein a Month is added to make the *Lunar* correspond with the *solar* Account of Time. By this Method, the *Jews* kept their Account of Time, according to the *Lunar* Motion. But, by adding no more than a Month of 30 Days, called *Ve-Adar*, every third Year, in their Account, it fell Short of the *solar* Reckoning, in that Time, by about $3\frac{3}{4}$ Days.

The

DIVISION *of* TIME.

Roman Year. *Vacant, Lunar.*

The fiift *Romans* ufed the *Lunar, Vacant,* or *Embolimic,* Year, as it was fettled by *Romulus* the firft King, and Founder of *Rome,* who made it confift of ten *Lunar* Months, or Lunations, and therefore terminated 61 Days fhort of the folar Year; by which the Seafons in the *Roman* Year were unfixed, and wandering, in the Month days on which they fell: Whence they had a Table publifhed by their *High Prieft* to appoint the Time of their Spring and other Seafons. *Julius Cæfar,* confidering this Difficulty, reformed the *Calendar* (as aforefaid) by making the Year confift of 365 Days and Six Hours, reckoning the Hours every fourth Year only, confifting of 366 Days. But the *Julian* Account of Time, thus ftated, required a ftill farther Correction, by the *Equinoxes* failing back about a Day in 130 Years, and unfixing the Times of the Seafons, and the Fall of *Eafter,* and confequently of the other *Feafts* thereon depending. Therefore POPE GREGORY XIII. took the *Calendar* in Hand, and, in the Year 1582, ordered (as before obferved) the 5th of *October* to be called the 15th. By this Means he reftored 10 Days the Seafons had retreated, fince the *Niccene Council, Anno Chrifti* 325, and reduced the *Julian* to the *Gregorian* Account of Time. Who, by reckoning 3 Days lefs in 400 *Gregorian* Years, for the Time to come, made the *civil* or *political,* nearly to keep Pace with the Solar Years.

Of MONTHS.

Month. The MONTHS are of two Sorts, *aftronomical* and *civil.*

Aftronomical. *Civil.* The *aftronomical* Month is the Time in which the Moon goes through the *Zodiac,* and beyond; and is either *periodical* or *fynodical.*

Periodical. The *Periodical* Month is the Time in which the Moon makes a complete Revolution from any Point in the *Ecliptic* to the fame again, which, at a Mean Rate of Motion, is in $27^d\ 7^h\ 43^m\ 5^s$, as has been computed.

Synodical. The *Synodical* Month, called alfo a *Lunation,* is the *Interval* of Time between two next Conjunctions of the Moon and Sun, being $29^d\ 12^h\ 44^m\ 3^s$, at a mean Rate of Motion, as has been computed.

Civil. The *Civil Months* are limited for the Purpofe of civil Life; and differ in their *Names, Number* of Days, alfo Beginning and Ending, according to the Cuftom in different Nations.

The *firft* Month of the *Jewifh* Year happened according to the Moon, in our *Auguft* and *September*; the Second *Jewifh* Month in *September* and *October,* &c. O. S.

Antient. The *Firft* Month of the *Egyptian* Year began on the 29th of our *Auguft,* O. S.

The *Firft* Month of the *Arabic* and *Turkifh* Year began the 16th of our *July,* O. S.

The *Firft* Month of the *Grecian* Year happened, according to the Moon, in our *June* and *July*; the *Second* in *July* and *Auguft,* &c. O. S. as fet down in the following *Table,* ufeful in *antient* Aftronomy.

DIVISION of the YEAR by the ANTIENTS.

The JEWISH YEAR.

No.	Jewifh Months.	Fell on our Ms, O. S.		Days
1	*Tifri* . . .	Aug.	Sept.	30
2	*Marchefvan* . .	Sep.	Oct.	29
3	*Cafleu* . . .	Oct.	Nov.	30
4	*Tebeth* . . .	Nov.	Dec.	29
5	*Shebat* . . .	Dec.	Jan.	30
6	*Adar* . . .	Jan.	Feb.	29
7	*Nifan,* or *Abib*	Feb.	Mar	30
8	*Jiar* . . .	Mar.	Apr.	29
9	*Sivan* . . .	Apr.	May	30
10	*Tamuz* . .	May	June	29
11	*Ab*	June	July	30
12	*Elul* . . .	July	Aug.	29
	Days in the Year			354

In the *Embolimic* Year, after *Adar,* they added a Month called *Ve-Adar,* of 29 Days. but the other author has 30

The *Egyptian* YEAR.

No.	Egyptian Ms.	fell on our Ms, O. S.		Days
1	*Thoth* . .	Auguft	29	30
2	*Paophi* . .	Sept.	28	30
3	*Athir* . .	Oct.	28	30
4	*Chojac* . .	Nov.	27	30
5	*Tybi* . . .	Dec.	27	30
6	*Mechir* . .	Jan.	26	30
7	*Phamenoth* .	Feb.	25	30
8	*Pharmuthi* .	March	27	30
9	*Pachon* . .	April	26	30
10	*Payni* . .	May	26	30
11	*Epiphi* . .	June	25	30
12	*Meferi* . .	July	25	30
	Epagomenæ, or Days added			5
	Days in the Year . .			365

The *Arabic* and *Turkifh* YEAR.

No.	Arabian Mths.	fell on our Ms, O. S.		Days
1	*Muharram* .	July	16	30
2	*Saphar* . .	Auguft	15	29
3	*Rabia* I. .	Sept.	13	30
4	*Rabia* II. .	Oct.	13	29
5	*Jomada* I. .	Nov.	11	30
6	*Jomada* II. .	Dec.	11	29
7	*Rajab* . .	Jan.	9	30
8	*Shaſban* . .	Feb.	8	29
9	*Ramadan* .	March	9	30
10	*Shawal* . .	April	8	29
11	*Dulhaadah* .	May	7	30
12	*Dulheggia* .	June	5	29
	Days in the Year . .			354

They *add* 11 Days at the End of each Year to keep the fame Months to the fame *Seafons.*

The *antient Grecian* YEAR.

No.	Old Grecian Months.	Fell on our Ms, O. S.		Days
1	*Hecatombæon*	June	July	30
2	*Metagitnion*	July	Aug	29
3	*Bœdromion*	Aug.	Sept.	30
4	*Pyanepfion*	Sept.	Oct.	29
5	*Mamacterion*	Oct.	Nov.	30
6	*Pofideon*	Nov.	Dec.	29
7	*Gamelion*	Dec.	Jan.	30
8	*Anthefterion*	Jan.	Feb.	29
9	*Elaphebolion*	Feb.	Mar.	30
10	*Munichion*	Mar.	Apr.	29
11	*Thargelion*	Apr.	May	30
12	*Schirophorion*	May	June	29
	Days in the Year			354

N. B. We would have inferted the Names of Week-Days ufed by each Nation; but wanted good Authority.

Common. A *common* Month is divided into 4 Weeks; of which Kind of Months there are 13, or 52 Weeks, in a *Julian* Year; befides 1 Day over, or 2 in *Biffextile.*

Week. A WEEK is divided into 7 Days, whofe Names are known. The antient *Gentiles* gave Names to the Days of the Week, from the Names of the *Planets,* which they fuppofed to prefide over them. The 1ft Day of the Week they denominated *Sun,* the 2d *Moon,* the 3d *Mars,* 4th *Mercury,* 5th *Jupiter,* 6th *Saturn.*

DIVISION *of* TIME.

Of Days.

Day. A Day is either *natural* or artificial, in Propriety of Distinction.

Natural. The *Natural* Day is divided into 24 Hours, from the same to the same Time.

Artificial. The *Artificial* Day is the Time from the Sun Rising to the Sun Setting of that Time.

The Natural Day is *Astronomical* or *Civil*.

Astronomical. The *Astronomical* Day begins at Noon and ends the Noon following. Astronomers find this Limit, of Beginning and Ending Day, fittest for their Purpose of Computation, by the diurnal Revolution of the Sun from Meridian to Meridian. For the Days would be much more *unequal* (as was observed if they begun and terminated at Sun Rising or Setting, or any other Time of the Sun's diurnal Revolutions, except at *Midnight*; which yet would not, so well as Noon to begin Time at, answer the Purpose of Calculation.

The *British*, *French*, *Dutch*, *Germans*, *Spanish*, *Portuguese*, and *Egyptians*, in common Reckoning, begin their Day at Midnight. The antient *Greeks*, *Jews*, *Bohemians*, *Silesians*, and modern *Italians* and *Chinese*, did, and now begin Day at Sun Setting.

The antient *Babylonians*, *Persians*, *Syrians*, and modern *Greeks*, did, and now begin Day at Sun Rising, according to the civil Custom of each Nation.

N. B. The *Italians* reckon the natural Day by 24 Hours of the Clock. Other Nations, by reckoning twice twelve of the Clock, prevent their Clocks striking 24, (like the *Italian* Clocks) at one Time.

Of Hours.

Hour. An Hour is divided into 60 Parts called *Minutes*.

The Hour is either equal or unequal.

Equal. An *equal* Hour is the 24th Part of a mean Day, measured by a well *regulated* Clock, or Watch.

Unequal. An *unequal* Hour of a natural Day, is measured by the Sun's *unequal* Motion in the *Ecliptic*, inclined to the Equator in an Angle of 23° 28′ ½, while 15°, and the $\frac{1}{24}$ of the Increase of R. A. for a Day, counted on the Equinoctial, successively passes the *Meridian*.

An *unequal* Hour is otherwise the $\frac{1}{12}$ Part of the *Artificial Day* from Sun Rising to Setting; and is also the $\frac{1}{12}$ Part of the Night, from Sun Setting to Rising, as reckoned by the *Jews*. These unequal or *Jewish Hours*, *increase* and *decrease* with the Length of Days and Nights. *For Length of* Jewish *or unequal Hours, see Ladies Diary for former Years, by the late Mr.* Henry Beighton, F. R. S.

Of Minutes *and* Seconds.

Minute. A Minute of Time is divided into 60 equal Parts, called *Seconds*, and each *Second* is divided

Second. into 60 equal Parts called *Thirds*, and so on, in a *Sexagesimal* Subordination.

The *Jews*, *Chaldeans*, and *Arabians* divide the Hour into 1080 equal Parts, or *Scruples*,

Scruples. containing 18 Times 60; whereby one Minute contains 18 *Scruples*.

Of Cycles, *or* Periods.

A *Cycle*, or Period, is a Revolution of Time.

Sun's Cycle. The Cycle of the *Sun*, or *Dominical-Letter*-Cycle, is a Revolution of 28 Years, in which *Interval* of Time, the Days of the Week in the *Julian* Account return to the same Days of the Month. And the Sun's Place never varies every 7 Times 4, or 28 Years, above 7 Times 1′ 53″ = 13′ 11″, on the same Month-day, not 50′ in 100 *Julian* Years, according to *Ferguson*'s Astronomy. After the *Completion* of this Cycle the Week days begin the same Order over again, with respect to the same *Month-days* of the *Julian* Reckoning, which is only interrupted by the common Hundredth *Gregorian* Year, coming between. *See Tables further on, of this Cycle for finding the Dominical Letter at Sight, according to both Stiles, for any Year before and since Christ.*

Moon's Cycle. The *Cycle* of the *Moon*, commonly called the Golden Number, is a Revolution of 19 Years in which *Interval* of Time, according to the *Julian* Account, (including the 6 odd Hours yearly) the Conjunctions, Oppositions, and other Aspects of the Moon with the Sun, are within an Hour and a Half of the same Situation as they were on the same Month-days in the preceding Cycle. But this Cycle is interrupted a Day, like the Sun's Cycle, by the common Hundredth *Gregorian* Year coming between. *See the Tables further on, for finding the Golden Number at Sight, according to both Stiles, for any Year before and since Christ.*

Indiction. The Indiction-Cycle is a Revolution of 15 Years, only; used by the *Romans* for determining the Times of particular Payments by the Subjects to the Republic: Which *Cycle* was founded by *Constantine*, in the Year of *Christ* 312.

See Rules for determining the Numbers of each of these Cycles, arithmetically, *farther on.*

Of

Of the FIXED STARS.

Appear bigger to the naked Sight than through a Teleſcope.

They are ſo called, becauſe of the *Fixed Diſtance* they are generally obſerved to keep from one another: Their apparent *diurnal* Revolution in the Heavens to the Right ariſing only from the Earth's Rotation to the Left on its *Axis.* They appear of different *Magnitudes* from their different, but immenſe, Diſtances, at which they are placed, in the *infinite Space,* from our Sight, and are ſeen much bigger by the naked Eye than through a *Teleſcope,* magnifying 200 Times, taking off the ſcattered Rays, cauſing a *Radiation* or *Scintillation* to our Sight; and thereby renders their true Appearance ſo many diſtinct Points of native Light. If the Stars ſhone with borrowed and not *(as they do)* with native Light, they would be as inviſible without the Uſe of Teleſcopes, as the Satellites of *Jupiter,* any one of which appear bigger, when viewed by a Teleſcope, than the greateſt of the *Fixed Stars.*

The Number of *Fixed Stars* diſcoverable by the naked Eye, in either the *Northern* or *Southern* Hemiſphere, exceeds not a *Thouſand,* while they appear, at firſt Sight, to be *innumerable;* but the Deception is in looking *confuſedly,* and not *diſtinctly,* upon them.

The BRITISH CATALOGUE, conſiſting of a large Number of Stars, which cannot be ſeen without the Help of the *Teleſcope,* counts not above 3000 in both Hemiſpheres.

Stars made not to give Light in the Night only.

The Light of the *Moon* to this Earth in the Night-Time, being much ſuperior to the faint glimmering Light of the Stars, it follows from thence, that the *Stars* were not deſigned for giving Light in the Night only; becauſe many more than are viſible to the naked Eye require the Help of a *Teleſcope* to diſcover them. And, as our *Sun* is ſurrounded with a Syſtem of *Planets* and *Comets,* which would be inviſible from the *neareſt fixed Star,* it is probable that every Star is a *Sun* to a remote Syſtem of *planetary* Bodies, though inviſible to us at this Diſtance. This Plurality of innumerable Worlds quite conſiſts with the infinite *Power, Wiſdom,* and *Greatneſs* of the CREATOR OF ALL WE BEHOLD!

Stars of Six Magnitudes: the reſt Teleſcopic Stars.

The *Stars* on account of their different Appearance, have been diſtributed into *Six Claſſes,* or Magnitudes; the 6th being the leaſt Magnitude viſible to the naked Eye. This *Diſtribution* being made long before the Invention of *Teleſcopes,* thoſe Stars which cannot be ſeen without the Help of that Inſtrument are diſtinguiſhed by the Name of *Teleſcopic Stars.*

Of CONSTELLATIONS.

Stars readily known.

The *Antients,* to diſtinguiſh the Stars, divided the *Starry Sphere* into different *Conſtellations,* or Collections of Stars, ſituated next one another, in the Heavens, by drawing about them the *Out-lines* of different Things and Animals, according as they ſuppoſed a Collection of Stars to repreſent. Thoſe Stars, which could not be brought under any deſigned Forms, were denominated *unformed Stars.*

Thoſe *Conſtellations,* and likewiſe *unformed Stars,* are now repreſented on a *Celeſtial Globe,* by which any particular Star, and its Situation, in Reſpect of another, is readily known and diſtinguiſhed, by giving the moſt remarkable Stars the moſt remarkable Places.

The Number of the *antient* Conſtellations is 48, and the Number on our *modern* Globes about 70. *On* MARTIN's *Globes, being an Improvement on* SENEX's, *are inſerted* Bayer's *Letters. The* firſt *Letters of the* Greek Alphabet *are put to denote the* Magnitudes *of the Stars in each Conſtellation, nearly according to the Order of Magnitude from* α, *denoting the Star of the firſt Magnitude;* β *denoting that of the ſecond, &c. whereby the particular Magnitudes, and Names of the Stars are as truly defined and diſtinguiſhed, as if they were ſhewn us in the Heavens.* See MARTIN's GLOBES, in *Fleet-ſtreet, London.*

The *Starry Heavens* are divided into *three Parts,* 1ſt, the *Zodiac,* of 16 Degrees Breadth, quite round the Heavens, taking all the planetary Orbits, and Orbit of the Moon: Containing 12 Conſtellations; *Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius,* and *Piſces.* In the middle of this *Zone,* or Belt, is the Ecliptic, or Circle which the Earth annually deſcribes, as ſeen from the Sun; and which the Sun appears to deſcribe, as ſeen from our Earth. 2d, The *Region* of the Heavens on the *North Side* of the Zodiac, containing 21 *Conſtellations.* 3d, All the Region on the *South Side,* containing 15 *Conſtellations.*

The *Antients* divided the *Zodiac* into *twelve Parts* by the equal Dropping of twelve Parts of Water, (at *each* of which Parts dropped out, they noted a particular Star's Riſing) the whole 12 Parts having firſt dropped through a *ſmall Veſſel* into a *Receiver,* from the obſerved riſing of the ſame *Star* to its obſerved Riſing the Night following.

The Names of the *Conſtellations,* and different Stars, obſerved in each Hemiſphere, by different Aſtronomers, ſince the Improvement of Aſtronomy began, are as follow.

ANTIENT CONSTELLATIONS.

Numb.	Latin Names.	*Engliſh Names.*	*Ptolemy.*	*Tycho.*	*Hevelius.*	*Flamſteed.*
1	*Urſa Minor*	The Little Bear	8	7	12	24
2	*Urſa Major*	Great Bear	35	29	73	87
3	*Draco*	Dragon	31	32	40	80
4	*Cepheus*	Cepheus	13	4	51	35
5	*Bootes, Arctophilax*	Bootes	23	18	52	54
6	*Corona Borealis*	Northern Crown	8	8	8	21
7	*Hercules*	Hercules kneeling	29	28	45	113
8	*Lyra*	Harp	10	11	17	21
9	*Cygnus, Gallina*	Swan	19	18	47	81
10	*Caſſiopea*	Lady in her Chair	13	26	37	55
11	*Perſeus*	Perſeus	29	29	46	59
12	*Auriga*	Waggoner	14	9	40	66
13	*Serpentarius,* Ophiuchus	Serpentarius	29	15	40	74
14	*Serpens*	Serpent	18	13	22	64
15	*Sagitta*	Arrow	5	5	5	18
16	*Aquila,* Vultur	Eagle	15	12	23	
17	*Antinous*	Antinous		3	19	71
18	*Delphinus*	Dolphin	10	10	14	18
19	*Equulus,* Equiſectio	Horſe's Head	4	4	6	10
20	*Pegaſus,* Equus	Flying Horſe	20	19	38	89
21	*Andromeda*	Andromeda	23	23	47	66
22	*Triangulum*	Triangle	4	4	12	16

FIXED STARS.

ANTIENT CONSTELLATIONS continued.

Numb.	Latin Names.	English Names.	Ptolemy.	Tycho.	Hevelius.	Flamsteed.
23	*Aries*	Ram	18	21	27	66
24	*Taurus*	Bull	44	43	51	141
25	*Gemini*	Twins	25	25	38	85
26	*Cancer*	Crab	23	15	29	83
27	*Leo*	Lion	35	30	49	95
28	*Coma Berenices*	Berenices Hair		14	21	43
29	*Virgo*	Virgin	32	33	50	110
30	*Libra*, Chelæ	Scales	17	10	20	51
31	*Scorpius*	Scorpion	24	10	20	44
32	*Sagittarius*	Archer	31	14	22	69
33	*Capricornus*	Goat	28	28	29	51
34	*Aquarius*	Water Bearer	45	41	47	108
35	*Pisces*	Fishes	38	36	39	113
36	*Cetus*	Whale	22	21	45	97
37	*Orion*	Orion	38	42	62	78
38	*Eridanus*, Fluvius	The River	34	10	27	84
39	*Lepus*	Hare	12	13	16	19
40	*Canis Major*	Great Dog	29	13	21	31
41	*Canis Minor*	Little Dog	2	2	13	14
42	*Argo Navis*	Ship	45	3	4	64
43	*Hydra*	Hydra	27	19	31	60
44	*Crater*	Cup	7	3	10	31
45	*Corvus*	Crow	7	4	. . .	9
46	*Centaurus*	Centaur	37	. . .	. . .	35
47	*Lupus*	Wolf	19	. . .	. . .	24
48	*Ara*	Altar	7	. . .	. . .	9
49	*Corona Australis*	Southern Crown	13	. . .	. . .	12
50	*Pisces Australis*	Southern Fish	18	. . .	. . .	24

NEW SOUTHERN CONSTELLATIONS, discovered by MARINERS.

Numb. Const.	Latin Names.	English Names.	Stars Flamst.
1	*Columba Noachi*	Noah's Dove	10
2	*Robur Carolinum*	The Royal Oak	12
3	*Grus*	Crane	13
4	*Phœnix*	Phænix	13
5	*Indus*	Indian	12
6	*Pavo*	Peacock	14
7	*Apus*, Avis Indica	Bird of Paradise	11
8	*Apis*, Musca	Bee or Fly	4
9	*Chamæleon*	Chameleon	10
10	*Triangulum Australis*	South Triangle	5
11	*Piscis volans*, Passer	Flying Fish	8
12	*Dorado*, Xiphias	Sword Fish	6
13	*Toucan*	American Goose	9
14	*Hydrus*	Water Snake	10
		Sum	137

HEVELIUS's CONSTELLATIONS composed of *unformed Stars.*

Numb.	Latin Names.	English Names.	Hevelius.	Flamsteed.
1	*Lynx*	The Lynx	19	44
2	*Leo Minor*	Little Lion	. .	53
3	*Asterion* and *Chara*	Greyhound	23	25
4	*Cerberus*	Cerberus	4	. .
5	*Vulpecula & Anser*	Fox and Goose	27	35
6	*Scutum Sobieski*	Sobieski's Shield	7	. .
7	*Lacerta*	Lizard	10	16
8	*Camelopardus*	Camelopard	32	58
9	*Monoceros*	Unicorn	19	31
10	*Sextans*	Sextant	11	41
				303

Milky Way. The *Luminous Track*, round the Heavens, appearing single in some Places, and double in others, called the *milky Way*, from its Whiteness, is caused by the *numerous Stars* scattered therein, (*powdered with Stars as* Milton *terms it*) none of which can be distinctly seen but by the Means of good *Telescopes*.

Of Lucid *and* other Spots *in the* Heavens.

Several Lucid Spots. Several *luminous Spots*, in the Heavens, appear magnified, and more luminous, being seen through good *Telescopes*; but are void of Stars. One of which Spots is seen in *Andromeda*'s Girdle, first observed in the Year 1612, by *Simon Marius*, with *whitish* Rays near its Middle. This *luminous Spot* is subject to several *Changes*, and is sometimes invisible. Another of *these Spots* is seen near the *Ecliptic*, between the *Head and Bow of Sagittary*; being small, but very luminous. A *Third* is seen on the Back of *Cancer*, being too South to be visible in *England*. A *Fourth*, of a smaller *Size*, is seen in one *Antinous*'s Right Foot; with one Star in it, by which it appears the brighter. A *Fifth* is seen in the Constellation of *Hercules*, between the Stars of *Bayer*, ζ, and η, being visible, though appearing but small, to the naked Eye, when the Sky is clear and the Moon absent.

There

FIXED STARS.

Cloudy Stars. There are (besides the Appearances spoke of) *cloudy Stars* in the Heavens, so called from their appearing of a dim and misty Light to the naked Eye; but appear through a Telescope, to be broad *illuminated Parts of the Sky*, containing one, or more Stars. *Five* of these *cloudy Stars* are mentioned by *Ptolemy*. 1. *One*, at the Extremity of the Right-hand of *Perseus*. 2. *One*, in the midst of the *Crab*. 3. *One*, unformed, near the Sting of the *Scorpion*. 4. *The Eye of Sagittary*. 5. *One*, in the Head of *Orion*. In the *first* of these more Stars appear, through the Telescope, than in any of the rest; though 21 have been reckoned in *Orion*'s Head; and above 40 in the *Crab*. *Two* are visible in the *Eye of Sagittary*, without a Telescope; but several more appear by the Use of that Instrument. *Flamsteed* observed a *cloudy Star* in the Bow of *Sagittary*, containing many small Stars. *Cassini* and *Flamsteed* observed one between the *Great* and *Little Dog*, appearing full of Stars, only visible by the Telescope. The two *whitish Spots* near the South Pole, called the *Magellanic Clouds.* *Magellanic Clouds*, by Sailors, resembling the *Milky Way*, to the naked Eye, appear through Telescopes to be a Mixture of small Clouds and Stars.

But, the most remarkable of all the *cloudy Stars* is in the middle of *Orion*'s *Sword*, where *Seven* Stars (*three* of which are close together) seem to shine through a Cloud, very lucid near the middle; but faint and imperfect about the *Skirts*: looking like a *Gap* in the Sky, through which appears Part of a *brighter Region*. Though most of the *cloudy Spaces* are but a few Minutes of a Degree in Breadth, yet, as they are among the *Fixed Stars*, they must be every one larger Spaces than our *Solar System* occupies; as in which there seems to be a *perpetual uninterrupted Day*, among innumerable Worlds.

Of New Periodical Stars.

Changes of Stars. Several Stars are described by *antient* Astronomers not now to be found; and others are now visible to the naked Eye not recorded in antient Catalogues. *Hipparchus* observed a *new Star* about 150 Years before *Christ*, who has not mentioned in what Part of the Heavens it was seen; though it occasioned his making a *Catalogue* of the Stars the most antient of any that we now have.

The first *new Star* that we have any certain Account of was discovered by *Cornelius Gemma*, on the *8th of November*, 1572, in *Cassiopea*'s *Chair*. It surpassed *Sirius* in Magnitude and Brightness, and was seen for 16 Months in Succession. It appeared, at first, bigger than *Jupiter* to some Eyes, by which Means it was seen at *Mid-Day*; afterwards it decayed *gradually* in its Lustre and Magnitude, till *March* 1573, when it became invisible.

Periodical Stars. *On the 13th of* August, 1596, *David Fabricius* observed the *Stella Mira*, or wonderful Star, in the Neck of the *Whale*, since disappearing and appearing, *periodically*, seven Times in six Years, continuing in its greatest *Lustre*, for 15 Days together, which is never quite extinguished.

In the Year 1600, *William Jansenius* discovered a *changeable Star* in the Neck of the *Swan*, which, in Time, became so small, as made it thought to have disappeared till the Years 1657, 1658, and 1659, *when it recovered its former Lustre and Magnitude*; but soon decayed in both, and is now of the *smallest Size*.

In the Year 1604, *Kepler*, and several of his Friends, saw a *new Star* near the Heel of the Right Foot of *Serpentarius*, so bright and sparkling, that it exceeded any Thing of the Kind they before had seen, who observed that it was every Moment changing into some of the Colours of the Rainbow, except when it was *near the Horizon*, and generally appeared white. It exceeded *Jupiter* in Magnitude, which it was near during the Month of *October*, but distinguished from *Jupiter* by his steadier Light. This Star disappeared between *October* 1605 and *February* following, and has not since appeared.

In the Year 1670, *July* the 15th, *Hevelius* discovered a *new Star*, which, in *October* following was so decayed as to be hardly perceptible. In *April* following, it regained its former Lustre; but wholly disappeared in *August*. In *March* 1672 it appeared again very small, disappearing ever since.

In the Year 1686, a *new Star* was discovered by *Kirch*, disappearing and returning periodically in 404 Days.

In the Year 1672, *Cassini* observed a Star in the Neck of the *Bull*, which he judged was not visible in *Tycho*'s Time, nor yet when *Bayer* made his Catalogue.

Of Changes *in the* Heavens.

Periodical Stars accounted for. *Many Stars*, besides those before-mentioned, have been observed to change their Magnitudes and Appearances; but as none of them were ever observed to have *Tails*, 'tis concluded they could none of them be *Comets*; having no *Parallax* in their greatest Lustre and Magnitudes. It appears probable, that these *periodical Stars*, having vast Clusters of *dark Spots*, make slow Rotations on their own *Axes*; by which Means they disappear when the Side covered with Spots is turned towards us. And those Stars, breaking out of a sudden, with such resplendent Brightness, are probably *Suns of other Systems*, whose *Fuel* being much exhausted, acquire their Blaze and Splendor, continuing for some Time by the Accession of the Comets of that System, lodging on their Surface. *For, this* (according to Sir *Isaac Newton*) *appears to be the greatest Use and End of the Cometary Part of a System.*

And *M. Maupertuis*, in his Dissertation of the Figures of the *Celestial Bodies* (p. 61 to 63) is of Opinion, that *some Stars*, by their prodigious swift Rotation on their *Axes*, assume not only the Figures of flatted *Globes* next their Axes, but, by the great *centrifugal* Force, arising from such swift Rotations, may become of the Figure of *Mill-stones*, or even be reduced to *flat circular Planes*, so thin, as to be quite invisible when their Edges are turned towards us: As *Saturn's Ring* is invisible in such Positions. That, when very excentric *Planets*, or *Comets*, go round any *flat Star* in Orbits much inclined to its Equator, the Attraction of the Planets or Comets, in their *Perihelion*, must alter the *Inclination of the Star*; on which Account, it will appear more or less large and luminous, as its Broadside is more or less turned towards us. And thus he thinks we may account for the *apparent Changes of the Magnitude and Lustre of those Stars*; as likewise for their appearing and disappearing at certain *Intervals*.

Some of the *Stars*, particularly *Arcturus*, have been observed to change their Places, in the Heavens, above a *Minute* of a Degree, in Respect of the Situation of other Stars. But whether this is owing to any *real* Motion of the Stars themselves is the Business of *many Ages to determine*.

If our Solar System changes its Place, with Regard to *absolute Space*, it must, in Time, occasion an *apparent* Change in the Distances of the Stars from one another. And, in such a Case, the Places of the nearest Stars to us being more affected than those at a greater Distance, their relative Positions will seem to alter, though the Stars themselves were really *immoveable*. On the other hand, if our *System* remains at Rest, and any of the Stars of other Systems, have *real* Motion, in respect of infinite Space, their Positions will be changed thereby, and apparent Places, more or less, according as those Stars are nearer or further from us; and the swifter or slower those Motions are, and their Directions more or less suited to our Perception. And the same will happen from *real* and *different* Motions in the Systems themselves.

Ecliptic Obliquity changes. The *Obliquity* of the Ecliptic to the *Equinoctial* is, at present, about *one third* Part of a Degree less than *Ptolemy* determined it. For most of the Astronomers after him found this Obliquity to decrease gradually down to *Tycho*'s Time. If it be objected that we cannot depend on the Observations of the *antient* Astronomers, on Account of the *Incorrectness* of their Instruments, it may be urged, that *Tycho* and *Flamsteed* were both able Observators, and yet *Flamsteed* makes the Ecliptic Obliquity about 2½ *Min.* of a Degree less than *Tycho* did, about 100 Years before; which *Difference* can hardly arise from the different Cor-

FIXED STARS.

rectness of the Instruments with which they observed. For, *Ptolemy* lived 1324 Years before *Tycho*; and the *gradual* Decrease of Ecliptic Obliquity, nearly corresponds to the Difference of Time between these three *Great Astronomers*. Though the Variation of the Obliquity is shewn by Dr. *Bradley*, to depend on the Place of the *Moon's Node* through its Revolution, (*See Tab. p.* 33.) Yet, if we consider that the Earth is not a *perfect*, but a *flatted Sphere*, whose shorter *Axis* is less than its Equatorial Diameter, and that the *Sun* and *Moon* are continually and obliquely acting upon the greater Mass of Matter about the Equator, and attracting it to a nearer and nearer Coincidence with the Ecliptic, it will appear in some Degree probable, that the Attractions constantly diminish the Angle between the Planes of the *Ecliptic* and *Equator*. Nor is it less probable, (as the World is to be destroyed, or come to a Period, according to the *Scriptures*) that the *mutual* Attractions of all the Planets have a Tendency to bring the *Planes* of all their Orbits to a final *Coincidence*: Though the Effect be so small as not to produce a sensible Change in many Ages. *See Ferguson's Astronomy.*

——The Stars shall fade away, the Sun Himself
Grow dim with Age, and Nature sink in Years,
But thou shall flourish in immortal Youth,
Unhurt amidst the War of Elements,
The Wrecks of Matter and the Crush of Worlds! CATO.

Æras of Time.

As *Astronomers* begin their Computations from certain fixed Points in the Heavens, called *Æpochas*, or Radical Places; so Historians begin their Reckonings from certain fixed Points of Time, called *Æras*, or Radixes of Time. The most remarkable *Radixes* of Time are the *Æras* of Creation, the Greek *Olympiads*, the Building of *Rome*, of *Nabonassar*, the Death of *Alexander* the Great, the Birth of CHRIST, the *Arabian Hegyra*, and *Persian Yesdegird*. These, and others of less Note, are determined according to the *Julian* Period, Age of the *World*, and Years before and since *Christ*, as in the *following Table*.

REMARKABLE ÆRAS *and* EVENTS.
According to the Years of the *Julian Period*, of *Creation*, and of *Christ*.

No.	Remarkable *Æras*, or *Events*.	Yrs Jul. Per.	Yrs. of Cre.	Yrs. bef. Chr.	No.	Remarkable *Æras*, or *Events*.	Yrs. Jul. Per.	Yrs. of Cre.	Yrs. bef. Chr.
	THE					THE			
1	Creation of the World, by *Strauchius*	764	1	3949	26	*Persian* Monarchy founded by *Cyrus*	4154	3390	559
2	Deluge, or *Noah*'s Flood	2420	1656	2293	27	Battle of *Marathon*	4224	3460	489
3	*Assyrian* Monarchy, by *Nimrod*	2537	1733	2176	28	Beginning of the Reign of *Art. Longimanus*	4249	3485	464
4	Birth of *Abraham*	2712	1948	2001	29	Beginning of *Daniel*'s 70 Weeks	4256	3492	457
5	Beginning of the Kingdom of *Argives*	2856	2092	1857	30	Beginning of the *Peloponnesian* War	4282	3518	431
6	Beginning of the Kingdom of *Athens*, by *Cecrops*	3157	2393	1556	31	DEATH of ALEXANDER the GREAT	4390	3626	323
7	Departure of *Israelites* from *Egypt*	3216	2452	1497	32	Restoration of the *Jews*	4548	3784	129
8	Their Entrance in *Canaan*, or *Jubilee*	3256	2492	1457	33	Correction of the *Calendar* by *Julius Cæsar*	4669	3905	45
9	Destruction of *Troy*	3529	2865	1184	34	Beginning of the Reign of *Herod*	4673	3909	40
10	Beginning of King *David*'s Reign	3653	2889	1060	35	*Spanish Æra*	4675	3911	38
11	Foundation of *Solomon*'s Temple	3696	2932	1017	36	Battle at *Actium*	4683	3919	30
12	*Argonautic* Expedition	3776	3012	937	37	Taking of *Alexandria*	4683	3919	30
13	*Arbaces*, the I. King of the *Medes*	3838	3074	875	38	*Æra* of the Title of *Augustus*	4686	3922	27
14	*Mandaucus* the II.	3865	3101	848	39	TRUE ÆRA of CHRIST's BIRTH	4709	3945	4
15	*Sosarmus* III.	3915	3151	798	40	Death of *Herod*	4710	3946	3
16	*Artica* IV.	3945	3181	768	41	*Reputed* Æra of CHRIST, by *Dionysius exiguus*	4713	3949	0
17	*Cardica* V.	3996	3232	718					since
18	*Phraortes* VI.	4057	3293	656	42	*True* Year of CHRIST's DEATH	4746	3982	33
19	*Cyaxares* VII.	4080	3316	633	43	*Destruction* of *Jerusalem*	4783	4019	72
20	BEGINNING of the *Greek* OLYMPIADS	3938	3174	775	44	*Dioclesian* Persecution	5015	4251	30[illegible]
21	*Catonian* ÆRA of building ROME	3961	3179	752	45	*Æra* of *Constantine* the GREAT	5019	[illegible]	30[illegible]
22	ÆRA of NABONASSAR	3967	3202	746	46	*Council of Nice*	5038	4274	325
23	Destruction of *Samaria*	3990	3226	723	47	ÆRA of HEGIRA	5335	4571	62[illegible]
24	*Babylonish* Captivity	4133	3349	600	48	ÆRA of YESDEJERD	5344	4580	63[illegible]
25	Destruction of *Solomon*'s Temple	4124	3360	589	49	*Jallalæan Æra*	5791	5027	[illegible]
					50	*Æra* of the Reformation	6230	5466	1517

Of ÆRAS, CYCLES, *and* PERIODS.

THE *Solar* and *Lunar* Cycles of 28 and 19 Years, and *Roman Indiction* of 15 Years, multiplied together, produce the great *Julian Period* of 7980 Years; having its Beginning 764 Years before the supposed *Æra* of *Creation*, when all the three *Cycles* began together. And as the said *Julian Period* is not yet compleated, it therefore comprehends all other *Cycles*, *Æras*, and *Periods*. And as there is but *one* Year in the whole *Julian* Period, having the *same* Numbers or Parts of the *three* whole *Cycles*, of which the said *Period* is composed, therefore, if *Historians* had marked, in their Writings, the Numbers of the three Cycles for the Year in which any remarkable Event, or memorable Transaction happened, there could have been *no Dispute* about the Time of its happening.

To find the Year of the Julian *Period since Christ?* The *Dionysian*, or reputed, Æra of Christ's Birth, being about the End of the 4713 Year of the *Julian* Period.

RULE. *To the Current Year of Christ add* 4713, *the Sum will be the* Julian *Period.*

To find the Year of the Julian *Period before the* reputed *Coming of* Christ?

RULE. *Subtract the Number of the given Year before* Christ *from* 4714, *and the Remainder will be the* Julian *Period.*

ÆRAS, CYCLES, *and* PERIODS.

EXAMPLE I.	1759 Years since Christ.	EXAMPLE II.	1759 Years before *Christ*.
	4713 Year of *Julian* Period at *Christ*'s Coming.		4714 Year *Julian* Period at *Christ*'s Coming.
Sum,	6472 Year of *Jul.* Period 1759 Yrs since Christ.	Dif.	2955 Year *Jul.* Per. 1759 Years before *Christ*.

To find the Numbers of the three Cycles of the Sun, Moon, *and* Indiction *for a given Year of the* Julian *Period.*

RULE. Divide the given Year by 28, 19, and 15, respectively, and the three Remainders will be the Numbers of the Cycles *sought*. The three *Quotients* will be the Cycles compleated since the *Julian* Period began.

	Yr. Per.	Yr. Per.	Yr. Per.
Examples.	28) 4713 (168 Cycles since.	19) 4713 (248 Cycles since.	15) 4713 (314 Cycles since.
	Rem. 9 Cycle of *Sun*, or Dominical Letter.	Rem. 1 Cycle of Moon, or Golden Number.	Rem. 3 Cycle of *Indiction*. *All at the Birth of* Christ.

Of the BIRTH *and* DEATH *of* CHRIST.

THE *common Æra of Christ* is 4 Years later than the true *Æra*. For *Christ* was born before the Death of *Herod* the Great, who sought to kill him as soon as he heard of his Birth. And according to the Testimony of *Josephus (B. 15. Ch. 8.)* there was an Eclipse of the Moon in the Time of *Herod*'s last Sickness, a little before his Death. Which Eclipse some *Astronomical Tables* shew to have happened in the 4710 Year of the *Julian* Period, *March* 13^{d} 3^{h} 21^{m} after Midnight, at *Jerusalem*. Now, *Christ* must have been born some Months before *Herod*'s Death, because in the *Interval* (betwixt his Birth and *Herod*'s Death) he was carried into *Ægypt*, for Preservation of his Life. The latest Time therefore at which the true *Æra* of the Birth can be fixed is about the End of the 4709th Year of the *Julian* Period, which is four Years before the reputed *Æra*.

Christ died in the 4746 Year of the *Julian* Period on *Friday*, *April* 3, in the 33d Year of his Age, according to the reputed Æra, or 37th Year according to the true Æra, discovered by the Eclipse of the Moon happening a little before the Time of *Herod*'s Death. He was put on the Cross, at *Jerusalem*, at 12 o'Clock (as we reckon Time) and expired about three in the Afternoon: the whole Neighbourhood of *Jerusalem*, being overspread with a *miraculous* Darkness, during the Time of his Suffering.

This *miraculous Darkness*, (on the 4th Year of the 202d *Olympiad*) *Phlegon*, the *Trallian* (an Heathen Writer) mentions as an *Eclipse* of the Sun that then happened, through his Want of Knowledge in Astronomy. For it was full Moon about that Time, by Astronomical Tables, and consequently there could be no Eclipse of the Sun.

For ample Account of the Time of Christ's Crucifixion and Age, at his Death, see p. 42. *Palladium* 1753.

The *Reputed Æra* of *Christ*'s Birth was never settled till the Year of *Christ* 527: when *Dionysius Exiguus*, a *Roman* Abbot, fixed it at the End of the 4713th Year of the *Julian* Period; being four Years too late, for the Reason before given.

The Birth of CHRIST, according to *Nicholas Man*, Esq; in his *Chronology*, is proved to be just 6 Years before the said vulgar, or reputed, Æra; the Eclipse of the Moon, a little before *Herod*'s Death, happening on *March* the 13th, at 3 in the Morning.

But, that the ÆRAS OF CHRONOLOGY may be examined and settled on the Foundation of Truth; we here give the Reader Sir ISAAC NEWTON'S ASTRONOMICAL PRINCIPLES OF CHRONOLOGY; by which he determines the GRAND ÆRA of the *Argonautic Expedition* as the Foundation of all his Chronology.

He observes, that *Eudoxus*, in his Account of the Spheres of the Antients, placed the *Solstices* and *Equinoxes* in the Midst of the Constellations of *Aries*, *Cancer*, *Chelæ* and *Capricorn*; and that this Sphere or Globe was first made by *Museus*, and the *Asterisms* delineated upon it by *Chiron*, two Persons of the *Argonauts*.

It has been shewn, by the *Precession* of the *Equinoxes*, contrary to the Order of Signs, that the fixed Stars appear to go forward, in the Signs, 50″ a Year. And because at the End of the Year 1689, the *Equinoctial Colure*, passing through the middle Point, between the first and last Star of *Aries*, then did cut the Ecliptic in ♉ 6° 44′, it is thence evident, that the *Equinox* had then gone back 36° 44′, and therefore, As 50″ is to 1 Year, so 36° 44′, to 2645 Years, for the Time since the *Argonautic Expedition*, to the Beginning of the Year 1690, or 955 before *Christ*.

But, Sir *Isaac Newton* (in order to determine the Time more correctly) finds the mean Place of the Colure of the *Equinoxes*, and *Solstices*, by considering the several *Stars* they passed through among the different Constellations, according to *Eudoxus*, as follows.

In the Back of *Aries* is a *Star* of the 6th Magnitude, marked γ, by *Bayer*, in the End of the Year 1689, its Longitude was ♉ 9° 38′ 45″; and the Equinoctial *Colure* passing through, cut the Ecliptic, according to *Eudoxus*, in ♉ 6° 58′ 57″.

In the Head of *Cetus* are two Stars of the 4th Magnitude, called ν and ξ by *Bayer*: *Eudoxus*'s Colure passing in the Middle between them, cut the Ecliptic in ♉ 6° 58′ 51″, at the End of the Year 1689.

In the extreme Flexure of *Eridanus*, there was formerly a Star of the 4th Magnitude, (of late referred to the Breast of *Cetus*) being the only Star in *Eridanus*, through which the Colure can pass. Its Longitude was, at the End of the Year 1689, ♈ 25° 22′ 10″, and the Colure of the *Equinox* passing through it cut the Ecliptic in ♉ 7° 12′ 40″.

In the Head of *Perseus*, rightly delineated, is a *Star* of the 4th Magnitude, called τ by *Bayer*; its Longitude was ♉ 23° 25′ 30″, at the End of the Year 1689; and the Colure of the *Equinox*, passing through it, cut the Ecliptic in ♉ 6° 18′ 57″.

In the Right Hand of *Perseus*, rightly delineated, is a Star of the 4th Magnitude, whose Longitude, at the End of the Year 1689, was ♉ 24° 25′ 27″, and the *equinoctial Colure*, passing through it, cut the Ecliptic in ♉ 4° 56′ 40″.

The *Sum* of all these Five Places of the *Colure*	♉	6°	58′	57″
	♉	6	58	51
	♉	7	12	40
	♉	6	18	57
	♉	4	56	40
Is . . .	1ˢ	2	26	5
The 5th Part of which . . .	♉	6	29	13

The 5th Part of which . . . ♉ 6 29 13, is therefore the *mean Place*, in which the Colure in the End of the Year 1689, did cut the Ecliptic: *Taking the Mean of a Number of Observations.*

After this Manner Sir *Isaac Newton* determines the Mean Place of the *Solstitial Colure* to be in ♌ 6° 28′ 46″, which being *very nearly* 90° from the other Colure, shews the *Deduction* to be rightly made.

The *Equinoxes*, at this Time, having departed 1ˢ 6° 29′ from the *Cardinal* Points of *Chiron*, shew that 2628 Years have elapsed, *since that Time*, which is correcter than the former Number of Years, (though less by only 17) for the Time, since the *Argonautic Æra* to the Year of *Christ* 1689; making the *Argonautic Æra* about 938 Years before *Christ*.

By other similar Methods Sir *Isaac Newton* shews, that this *Æra* of the *Argonauts* ought to be placed in that Age of the World. And having determined this most *Antient Æra*, he makes his future Computations in Chronology with Reference thereto. Who, with great Skill and Penetration, has suited his Chronology to agree with the *Course of Nature*, the *Principles of Astronomy*, with *Sacred History*, with *Herodotus*, the Fathers of *profane History*, and with *Itself*. *Which great Author is therefore not to be contradicted but by his* EQUALS *in Judgment, or such, at least, as understand him.*

This Table requires 1 to be ded from given year and also the Table B C next Page

CHRONOLOGICAL TABLES.

DOMINICAL LETTERS for *Julian* or OLD STYLE, for ever.

YEARS before CHRIST.

YEARS *above* CENTURIES *before* CHRIST.				CENTURIES						
				0	100	200	300	400	500	600
				700	800	900	1000	1100	1200	1300
				1400	1500	1600	1700	1800	1900	2000
				2100	2200	2300	2400	2500	2600	2700
				2800	2900	3000	3100	3200	3300	3400
				3500	3600	3700	3800	3900	4000	4100
				DC	CB	BA	AG	GF	FE	ED
1	29	57	85	E	D	C	B	A	G	F
2	30	58	86	F	E	D	C	B	A	G
3	31	59	87	G	F	E	D	C	B	A
4	32	60	88	BA	AG	GF	FE	ED	DC	CB
5	33	61	89	C	B	A	G	F	E	D
6	34	62	90	D	C	B	A	G	F	E
7	35	63	91	E	D	C	B	A	G	F
8	36	64	92	GF	FE	ED	DC	CB	BA	AG
9	37	65	93	A	G	F	E	D	C	B
10	38	66	94	B	A	G	F	E	D	C
11	39	67	95	C	B	A	G	F	E	D
12	40	68	96	ED	DC	CB	BA	AG	GF	FE
13	41	69	97	F	E	D	C	B	A	G
14	42	70	98	G	F	E	D	C	B	A
15	43	71	99	A	G	F	E	D	C	B
16	44	72		CB	BA	AG	GF	FE	ED	DC
17	45	73		D	C	B	A	G	F	E
18	46	74		E	D	C	B	A	G	F
19	47	75		F	E	D	C	B	A	G
20	48	76		AG	GF	FE	ED	DC	CB	BA
21	49	77		B	A	G	F	E	D	C
22	50	78		C	B	A	G	F	E	D
23	51	79		D	C	B	A	G	F	E
24	52	80		FE	ED	DC	CB	BA	AG	GF
25	53	81		G	F	E	D	C	B	A
26	54	82		A	G	F	E	D	C	B
27	55	83		B	A	G	F	E	D	C
28	56	84		DC	CB	BA	AG	GF	FE	ED

YEARS since CHRIST.

YEARS *above* CENTURIES *since* CHRIST.				CENTURIES.						
				0	100	200	300	400	500	600
				700	800	900	1000	1100	1200	1300
				1400	1500	1600	1700	1800	1900	2000
				2100	2200	2300	2400	2500	2600	2700
				2800	2900	3000	3100	3200	3300	3400
				3500	3600	3700	3800	3900	4000	4100
				DC	ED	FE	GF	AG	BA	CB
1	29	57	85	B	C	D	E	F	G	A
2	30	58	86	A	B	C	D	E	F	G
3	31	59	87	G	A	B	C	D	E	F
4	32	60	88	FE	GF	AG	BA	CB	DC	ED
5	33	61	89	D	E	F	G	A	B	C
6	34	62	90	C	D	E	F	G	A	B
7	35	63	91	B	C	D	E	F	G	A
8	36	64	92	AG	BA	CB	DC	ED	FE	GF
9	37	65	93	F	G	A	B	C	D	E
10	38	66	94	E	F	G	A	B	C	D
11	39	67	95	D	E	F	G	A	B	C
12	40	68	96	CB	DC	ED	FE	GF	AG	BA
13	41	69	97	A	B	C	D	E	F	G
14	42	70	98	G	A	B	C	D	E	F
15	43	71	99	F	G	A	B	C	D	E
16	44	72		ED	FE	GF	AG	BA	CB	DC
17	45	73		C	D	E	F	G	A	B
18	46	74		B	C	D	E	F	G	A
19	47	75		A	B	C	D	E	F	G
20	48	76		GF	AG	BA	CB	DC	ED	FE
21	49	77		E	F	G	A	B	C	D
22	50	78		D	E	F	G	A	B	C
23	51	79		C	D	E	F	G	A	B
24	52	80		BA	CB	DC	ED	FE	GF	AG
25	53	81		G	A	B	C	D	E	F
26	54	82		F	G	A	B	C	D	E
27	55	83		E	F	G	A	B	C	D
28	56	84		DC	ED	FE	GF	AG	BA	CB

USE. The Dominical Letter ſtands *under* the Column of Centuries, or whole Hundreds, and *againſt* the Year (on the Left) above Centuries, *before Chriſt*, for the Letter *required*.

vide Pa 155. 157 170.

Conſtruction. There being a Revolution of the *Julian* Dominical Letter in every 700 *Julian* Years, any Number of *Julian* Years *before Chriſt*, will have the ſame *Julian* Dominical Letter as the *Complement* of thoſe Years to any Number of 700 Years, will have for Years *ſince Chriſt.*

Example.		Yrs.	Dom. Let.	
	7 Hundreds . . .	3500	G	3501
	Before Chriſt . .	—2563	. . ~~A~~	2563
	Comp. *ſince* Chr.	937	. . ~~A~~ G	938

USE. The *Dominical Letter* ſtands under the Column of *Centuries*, and againſt the Year (on the left) above Centuries, *ſince Chriſt*, for the Letter *required*.

Conſtruction. From the foregoing Argument reverted, any Number of *Julian* Years *ſince Chriſt*, will have the *ſame Julian* Dominical Letter as the *Complement* of thoſe Years to any Number of 700 Years will have for Years *before Chriſt.*

Example.		Yrs.	Dom. Let.	
	7 Hundreds	5600		5601
	Since Chriſt . .	—3666	. . F.	3666
	Comp. bef. Chr.	1934	. . F.	1935

N. B. By encreaſing the Columns of Hundreds by Sevens, the Dominical Letter may be found for any Number of *Julian* Years *before* or *ſince* CHRIST; though never ſo great.

In Leap-Year the 1ſt Dominical *Letter ſerves to the 24th of* February, *excluſive*, (*24th being* twice *reckoned, or* 24 *and* 25 *the ſame Month-day in the* Roman *Calendar in* Biſſextile, *have the ſame Letter*) *the Second* Dominical *Letter ſerves for the Reſt of the Year.* But in our *Engliſh Calendar* this extraordinary Day is added on the 29th of *February*.

CHRONOLOGICAL

CHRONOLOGICAL TABLES.

DOMINICAL-LETTERS for *Gregorian* or NEW STYLE, for ever.

YEARS *before* CHRIST.

YEARS *above Centuries before* CHRIST.				CENTURIES			
							0
				100	200	300	400
				500	600	700	800
				900	1000	1100	1200
				1300	1400	1500	1600
				1700	1800	1900	2000
				2100	2200	2300	2400
				2500	2600	2700	2800
				2900	3000	3100	3200
				3300	3400	3500	3600
				3700	3800	3900	4000
				G	E	C	B A
1	29	57	85	A	F	D	C
2	30	58	86	B	G	E	D
3	31	59	87	C	A	F	E
4	32	60	88	E D	C B	A G	G F
5	33	61	89	F	D	B	A
6	34	62	90	G	E	C	B
7	35	63	91	A	F	D	C
8	36	64	92	C B	A G	F E	E D
9	37	65	93	D	B	G	F
10	38	66	94	E	C	A	G
11	39	67	95	F	D	B	A
12	40	68	96	A G	F E	D C	C B
13	41	69	97	B	G	E	D
14	42	70	98	C	A	F	E
15	43	71	99	D	B	G	F
16	44	72		F E	D C	B A	A G
17	45	73		G	E	C	B
18	46	74		A	F	D	C
19	47	75		B	G	E	D
20	48	76		D C	B A	G F	F E
21	49	77		E	C	A	G
22	50	78		F	D	B	A
23	51	79		G	E	C	B
24	52	80		B A	G F	E D	D C
25	53	81		C	A	F	E
26	54	82		D	B	G	F
27	55	83		E	C	A	G
28	56	84		G F	E D	C B	B A

USE. The *Dominical Letter* stands under the Column of *Centuries*, or whole Hundreds, and against the Year (on the Left) above Centuries, *before Christ*, for the *Letter required.*

Construction. There being a Revolution of the *Gregorian* Dom. Letter every 400 *Greg.* Years, *any* No. *of Years before Christ* will have the same *Greg. Dom. Letter* as the Complement of those Years to any No. of 4 Hundred Years will have *for Years since Christ.*

		Ys.	Dom.L.
Ex.	4 Hundreds . .	3600	
	Before Christ . .	—1793	D C B
	Comp. *since* Christ	1807	D C B

So for the Rest.

N. B. Tho' there was no N. Style before Pope *Gregory* ordained it, in 1582, (by calling the 5 *Oct.* O. S. the 15 N.) yet the Years may be thus computed in *conformity* to our present *Style.*

YEARS *since* CHRIST.

YEARS *above Centuries since* CHRIST.				CENTURIES			
							0
				100	200	300	400
				500	600	700	800
				900	1000	1100	1200
				1300	1400	1500	1600
				1700	1800	1900	2000
				2100	2200	2300	2400
				2500	2600	2700	2800
				2900	3000	3100	3200
				3300	3400	3500	3600
				3700	3800	3900	4000
				C	E	G	B A
1	29	57	85	B	D	F	G
2	30	58	86	A	C	E	F
3	31	59	87	G	B	D	E
4	32	60	88	F E	A G	C B	D C
5	33	61	89	D	F	A	B
6	34	62	90	C	E	G	A
7	35	63	91	B	D	F	G
8	36	64	92	A G	C B	E D	F E
9	37	65	93	F	A	C	D
10	38	66	94	E	G	B	C
11	39	67	95	D	F	A	B
12	40	68	96	C B	E D	G F	A G
13	41	69	97	A	C	E	F
14	42	70	98	G	B	D	E
15	43	71	99	F	A	C	D
16	44	72		E D	G F	B A	C B
17	45	73		C	E	G	A
18	46	74		B	D	F	G
19	47	75		A	C	E	F
20	48	76		G F	B A	D C	E D
21	49	77		E	G	B	C
22	50	78		D	F	A	B
23	51	79		C	E	G	A
24	52	80		B A	D C	F E	G F
25	53	81		G	B	D	E
26	54	82		F	A	C	D
27	55	83		E	G	B	C
28	56	84		D C	F E	A G	B A

USE. The *Dominical Letter* stands under the Column of *Centuries*, and against the Year (on the Left) above Centuries, *since Christ*, for the *Letter required.*

Construction. In every 4 Hundred *Gregorian* Years there are 20871 Weeks just, or 3 Days less than in the same No. of *Jul.* Years; hence a *Revolution* of the *Dominical Letter* every 4 Hundred *Gregorian* Years is evident.

N. B. The *Dominical Letter* for any Number of Years *since Christ* will be the same, as the Dominical Letter for the Complement of those Years to any Number of 4 Hundreds, *before Christ.*

		Yrs.	D. L.
Ex.	4 Hundreds . .	4000	
	Since Christ . .	—2333	A
	Comp. *before Christ*	1667	A

So for the Rest.

WEEK *and* MONTH-DAY. Shewing, by the *Sunday Letter*, of either Style, the Day of the Week to *any Day* of the *Month*, in that Year, for ever.

MONTHS.	SUNDAY-LETTERS. A	B	C	D	E	F	G
	1	2	3	4	5	6	7
JANUARY 31	8	9	10	11	12	13	14
OCTOBER 31	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31	1	2	3	4
	5	6	7	8	9	10	11
FEBR. 28. 29	12	13	14	15	16	17	18
MARCH 31	19	20	21	22	23	24	25
NOVEMBER 30	26	27	28	29	30	31	1
	2	3	4	5	6	7	8
APRIL 30	9	10	11	12	13	14	15
JULY 31	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30	31	1	2	3	4	5
	6	7	8	9	10	11	12
AUGUST 31	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31	1	2
	3	4	5	6	7	8	9
SEPTEMBER 30	10	11	12	13	14	15	16
DECEMBER 31	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31	1	2	3	4	5	6
	7	8	9	10	11	12	13
MAY 31	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31	1	2	3
	4	5	6	7	8	9	10
JUNE 30	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	

USE. Under the *Sunday-Letter*, for the Year, and against the Month, is the *Sunday-Column*, of all the *Sundays* in that Month, for that YEAR. Next to which, on the Right, is the *Monday*-Column, next *Tuesday*-Column, &c. Whence all the *Week-Days* of that Month are immediately known.

Example 1. *To find on what Week the 12th of* June *happened* 455 *Years since Christ, N. S.*

The Dominical Letter was (by the foregoing Table) C. — Now, under C, against *June* 6, 13, 20, 27 is the *Sunday*-Column; next to which (on the Left) is the *Saturday*-Column, wherein is found 12, which therefore was on a *Saturday*, required.

Example 2. *Required the Week-day of* September 19, 1777 *Years* before Christ, *according to N. S.?*

The *Dominical Letter* is found E. D C

Hence, under E, against *September* (to the Left) the *Sunday*-Column is 7, 14, 21, 28, all the *Sundays* in that Month; and to the Left the 19th Day is in the *Friday*-Column, which therefore was on a *Friday*, required.

Hence *Apr.* 3d, 33 Ch. O. S. was on a *Fri*[illegible]ay: *Christ's Crucifixion.*

And *May* 28th, 585 bef. Chr. on *Mo*[illegible] after a Battle between the *Medes* and *Ly*[illegible] *Wednesday*, according to *Ferguson's* [illegible] *Astronomy*; which *Author mistakes* the 1st of Chr. [illegible] the Year before) *Christ*: W[illegible] thereby differs in his chronological *Æras.*

N. B. By increasing the Columns of Hundreds by Fours, the Dom. Letter may be found for any No. of [illegible]ough never so great.

[illegible] *Greg.* Years before or since *Christ*,

CHRONOLOGICAL TABLES.

The GOLDEN NUMBER, at *Sight*, for any YEAR before or since CHRIST.

N. B. The *Golden Number* for *Old* and *New* Style is the same, and takes Place, at the Beginning of the Year, with the *Dominical Letter* for each *Style*.

Before CHRIST. Hundreds of YEARS.			*Since* CHRIST. Hundreds of YEARS.		
5700	3800	1900	0	1900	3800
5600	3700	1800	100	2000	3900
5500	3600	1700	200	2100	4000
5400	3500	1600	300	2200	4100
5300	3400	1500	400	2300	4200
5200	3300	1400	500	2400	4300
5100	3200	1300	600	2500	4400
5000	3100	1200	700	2600	4500
4900	3000	1100	800	2700	4600
4800	2900	1000	900	2800	4700
4700	2800	900	1000	2900	4800
4600	2700	800	1100	3000	4900
4500	2600	700	1200	3100	5000
4400	2500	600	1300	3200	5100
4300	2400	500	1400	3300	5200
4200	2300	400	1500	3400	5300
4100	2200	300	1600	3500	5400
4000	2100	200	1700	3600	5500
3900	2000	100	1800	3700	5600

0	YEARS above Hundreds before CHRIST.														99	98	97	96
95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77
76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58
57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39
38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20
19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

YEARS above Hundreds since CHRIST.																		
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
95	96	97	98	99														

GOLDEN NUMBERS before and since CHRIST.																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5
11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10
16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1
7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6
12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11
17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2
8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7
13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12
18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3
9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8
14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13
19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4
10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9
15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14

CONSTRUCTION. The *First Column* of the *Golden Numbers*, contains all *Those* for *Centuries* of Years *before* and *since Christ*; and the following Columns contain all *Those* counted in Succession, for Years above Centuries since *Christ*, or, in Retrogression, for Years above Centuries before *Christ*.

By which Construction of the *above Table*, any Number of Years *before* Christ, and their Complement to any Number of 19 Centuries, for Years since Christ, will have the same Golden Number, and the *contrary*.

EXAMPLE. *To find the Golden Number for* 1789 *Years since* Christ? *and also for* 1611 *Years before* Christ?

Against { 1700 / 1600 } Years and under { 89 since / 11 before } Years Christ stands { 4 / 5 } Golden Number required.

Likewise { 19 Hundreds . . 3800 / *Before* Christ —1611 } Years The contrary { 19 Hundreds . . 1900 / *Since* Christ —1789 } Years

Complement since Christ 2189 . ~~5~~ as before. G.No
2190 = 6

Complement before Christ 111 . 4 as before. G.No

ARITHMETICALLY.

To find the Golden Number before Christ?

RULE. *Divide* the Years before *Christ* by 19, and the *Remainder* being taken from 20, will leave the *Golden* Number for that Year. If Nothing remains the Golden Number is 1.

```
   Year
19)1611(84
   152
   ---
    91
    76
   ---
    15
    20
   ---
     5 Golden Number required.
```

To find the Golden Number since Christ?

RULE. *Add* 1 to the Years since *Christ*, and divide the *Sum* by 19, what remains will be the *Golden* Number for that Year. And if 0 remains the Golden Number is 19.

```
   Year
   1789
    +1
   ----
19)1790(94
   171
   ---
    80
    76
   ---
     4 Golden Number required.
```

CHRONOLOGICAL TABLES.

A TABLE, to find the *Place* or *Sign* of the Moon, *nearly*, by the *Golden Number* and Days of the Month, till 1899; which will serve for ever, by adding the Days the *Moon*'s go forward in the Month-Days, for a given Period, beyond that Time.

According to the *Gregorian* or *New Style*.

London Meridian.

Months.	Golden Numbers	Advance Days																											The ☽'s Pl. or Sign
Jan. Oct.	7	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	
		2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	♈
	18	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	
	10	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	♉
Fe. Mar. No.	2	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	
		6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	♊
December	13	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	
	5	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	♋
April		9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	
	16	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	
	8	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	♌
May		12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	
	19	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	14	♍
	11	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	15	
	3	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	16	♎
June		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	17	
	14	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	18	♏
July	6	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	19	
		19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	20	♐
	17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	21	
	9	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	22	
August	1	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	23	♑
		23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	24	
	12	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	25	♒
	4	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	26	
September		26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	27	
	15	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	♓

EXAMPLE of the USE.

N. B. *Every Sign makes* 2 $\frac{5}{18}$ *Days, from* ♈ *to* ♓.

To find the Place or Sign of the Moon, *for* July 10, 1764, *the Golden Number being* 17?

Against *July* stands 1, under or above which, stands the Day of the Month, *viz.* 10, against which, on the Left, stands 27, *Advance Days*, and the Golden Number being 17, against which stands 1, to the right Hand, under, or above, which, stands the *Advance-Days*, *viz.* 27; against which, to the Right, stands the first Part of *Sagittarius*, for the *Place* or *Sign* the Moon will be in, required.

By the Reverse Method the Day of the Month may be found to any Sign.

To find the Place or Sign of the Moon, *for* April 29, 1765, *the Golden Number being* 18?

Against *April* stands 1, under which stands 2, for the 29th Day, (the 1st being always 28, when the Day of the Month is above 27) against which, to the Left, stands 10, for the *Advance-Days*. But against the Golden Number 18, stands 1, under, or above which, stand those same 10 *Advance-Days*, against which, to the Right, stands the latter Part of *Leo* for Answer. And the like for all other Cases.

CONSTRUCTION.

Any Golden Number is chosen to stand against any Month, (to begin with *January* is best) so as the Number of *Advance-Days*, standing to the Left, against the Day of that Month, being found under 1, placed against the Golden Number, shall shew the *fore* or *latter* Part of the Sign the Moon is in, to the *Right* Hand of that Number of *Advance-Days*; which being determined for any *one Day of any Month*, the Rest of the Months must be placed *forward* or *backward*, in such Order of Succession, or Retrogression, that the 1st Day, next to 27 Days, be reckoned 28; the 2d, the 29th, and so on, to the present Month's End: observing, that as but 27 Days are reckoned for the Moon's going through all the Signs, instead of 27 Days, 7 Hours, and about 43 Minutes, that each third succeeding Month begins a Day later, or at 82 Days End, by counting forward: otherwise the Sign will go on too fast by 7 Hours and 43 Minutes every 27 Days, or in about a Month.

When the Moon's Place *is ascertained* to the Golden Number for any Year, and the Moon's Mean Place being known to go forward by 13 Days in each *Leap Year*, or by 10 Days in each *Common Year*, every Golden Number advanced by 4, or 1, must be placed 13 or 10 Days forward of the former Golden Numbers respectively, which will always point out, (by carrying the Advance-Days so much forward) *the Place or Sign of the Moon*, for any *Year and Month-Day*, required.

CHRONOLOGICAL TABLES.

A TABLE, shewing the *Moon's* Age by the *Golden Number*, to any Day of the Month, till 1899. Which will serve *for ever*, by subtracting the Days the Moon's Age retreats, or the *New*, *Full*, or *Quarter Moons* go *forward*, in the Month-Days, for a given Period, beyond that Time.
According to the *Gregorian* or *New Style*.
London Meridian.

Months.	Golden Numbers	Advance Days.																														Moon's Age	Moon's Phaces
	7	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
	18	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	
		3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	
	10	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	
		5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	
	2	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	
Jan. March	13	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	
		8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	☽ F.
Fe. Ap. May	5	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	Q.
June	16	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	
July		11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	
	8	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	
August	19	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	
September		14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
October	11	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	O
November		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	F.
December	3	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	17	M.
	14	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	18	
		19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	19	
	6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	20	
	17	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	21	
		22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	22	☾
	9	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	23	L.
		24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	24	Q.
	1	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	25	
	12	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	26	
		27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	27	
	4	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	28	N.
	15	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	29	M.
		30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	30	●

EXAMPLE of the USE.

TO find the Age of the Moon, the 14th of August, 1760, *the* Golden Number *being* 13?

Against *August* stands 1, above, or under which find the Day of the Month, *viz.* 14; against which to the left Hand stands 26, the N°. of *Advance Days*; Against 13, the *Golden Number* for the Year, stands 1, under, or above which, stands the N°. of Advance-days, *viz.* 26, against which to the right Hand stands the 2d Day of the Moon in the first Quarter, for Answer.—— The Converse finds the Day of the Month to any *New*, *Full*, or *Quarter* Moon.

TO find on what Day the Moon *will be at* Full *in* April 1759, *the* Golden Number *being* 12?

Against 12 the *Golden Number* for the Year, stands 1, under, or above, which, against the *Full* Moon, stands the N°. of Advance Days, *viz.* 20, against which, of the Advance Day Column, in the Month-Day Column for *April*, to the Right, stands the 12th Day for Answer. And so for other Cases.

CONSTRUCTION.

Any Golden Number is chosen for any Month (to begin with *January* is best) so as the Number of *Advance*-Days, standing to the Left against the Day of that Month, being found under 1, placed against the *Golden Number*, shall shew the Day of the Moon, to the *Right Hand* of that Number of *Advance-Days*; which being determined for *any one Day of any Month*, the Rest of the Months must be placed *forward* or *backward*, in their Order of Succession, or Retrogression; but so as the *first Day*, next to 30 Days, be reckoned the 31st Day of that Month; observing, that as 30 Days are reckoned for the Time of a *Mean Lunation*, instead of 29 Days, 12 Hours, 44 Minutes, and about 3 Seconds, that each *Second Succeeding Month* begins a Day sooner, or at 59 Days End, by counting forward; otherwise the *Lunations* will proceed too slow by 12 Hours, 44 Minutes, and 3 Seconds in every 30 Days, or about a Month.

When the *Moon's Age* is ascertained for *any* Year, to the Golden Number for that Year, the *Lunations*, or Lunar-Cycles, being known to *retreat* 14 Days every *four* Years, or 11 Days every succeeding Year, the Moon's Age comes forward as much; whereby the Golden Numbers for *four* Years, and *one* Year forward, must be advanced 14 and 11 Days, respectively, of the *former Golden Numbers*; which always *point out*, (by carrying the *Advance-Days forward with them*, answerable to any Day of the Month) *the Day of the Moon's Age required*.

CHRONOLOGICAL TABLES.

A TABLE of the *Sun's Place* throughout the Year; by which the *Moon's Place* may be found, and her *Rising* and *Setting* nearly, for *London*, or any Part of the known World. According to *New Style*.

Days of Mth	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	☉♑	☉♒	☉♓	☉♈	☉♉	☉♊	☉♋	☉♌	☉♍	☉♎	☉♏	☉♐
1	9 11°	13°	9 11	12°	17 11	6 11	6 9	14 9°	3 9°	11 8°	9°	19 9°
2	12	17 14	12	17 13	12	12	10	3 10	11 10	9	19 10	10
3	17 13	6 15	17 13	14	6 13	14 13	3,14 11	11	11	19 10	8 11	8 11
4	14	16	14	6 15	14	3 14	12	11 12	19 12	11	12	12
5	6 15	14 17	6 15	14 16	14 15	15	11 13	19 13	8 13	8 12	16 13	16 13
6	14 16	18	16	3 17	3 16	11 16	14	14	14	10 13	14	5 14
7	17	3 19	3,14 17	11 18	11 17	19 17	19 15	8 15	16 15	14	5 15	15
8	3 18	11 20	18	19	18	17	8 16	16 16	16	5 15	13 16	1 16
9	19	21	11 19	19 20	19 19	8 18	17	17	5 17	16	17	17
10	11 20	19 22	19 20	21	8 20	19	16 18	5 18	13 18	13 17	2 18	2 18
11	19 21	8 23	21	8 22	21	16 20	19	19	19	18	19	10 19
12	8 22	16 24	8 22	23	16 22	5 21	5 20	13 20	2 20	2 19	10 20	20
13	23	25	23	16 24	23	22	13 21	21	21	10 20	18 21	18 21
14	16 24	5 26	16 24	5 25	5 24	2,13 23	22	2 21	10 21	21	7 22	7 22
15	25	27	25	26	13 24	24	2 23	10 22	18 22	18 22	23	15 23
16	5 26	13 28	5 26	13 27	25	25	24	23	7 23	7 23	15 24	24
17	13 27	2 29	13 27	28	2 26	10 26	10 25	18 24	24	15 24	4 25	4 25
18	28	30	28	2 29	27	27	7,18 26	7 25	15 25	25	26	12 26
19	2 29	10 ♓ 1	2 29	10 30	10 28	18 28	27	15 26	26	4 26	12 27	27
20	10 30	18 2	30	♉ 1½	18 29	7 29	15 28	27	4 27	12 27	28	1 28
21	♒ 1	3	10 ♈ 1	15 1	7 ♊ 1¼	15 30	29	4 28	12 28	28	1 29	29
22	18 2	7 4	18 2	7 2	1	♋ 1	4 30	12 29	29	1 29	9 30	9 ♑ 1
23	3	5	7 3	15 3	15 2	4 2	♌ ½	30	1 30	30	♐ 1	17 2
24	7 4	15 6	15 4	4	4 3	12 3	12 1	1 ♍ 1	9 ♎ 1	9 ♏ 1	17 2	3
25	15 5	4 7	5	4 5	4	4	2	2	2	17 2	3	6 4
26	4 6	12 8	4 6	6	12 5	1 5	1 3	9 3	17 3	6 3	6 4	14 5
27	7	9	7	12 7	6	6	9 4	17 4	4	4	14 5	6
28	12 8	1 10	12 8	1 8	1 7	9 7	17 5	5	6 5	5	3 6	3 7
29	9		9	9	9 8	17 7	6	6 6	14 6	14 6	7	11 8
30	1 10		1 10	9 10	9	6 8	7	14 7	7	3 7	11 8	9
31	9 11		9 11		17 10		6 8	8		11 8		10

For finding the Moon's Place.		For finding ☽'s ris. & set.	High Water at London.	No. of the Sign.
☽ Age.	☽'s Sig. and Degree.	☽ Souths.		
	S °	h m	h m	
1	0 13	12 A 48	3 A 43	♈ 0
2	0 26	1 36	4 20	
3	1 9	2 24	4 52	
4	1 23	3 12	5 22	♉ 1
5	2 6	4 0	5 52	
6	2 19	4 48	6 26	
7	3 2	5 36	7 7	♊ 2
8	3 15	6 24	7 55	
9	3 28	7 12	8 50	♋ 3
10	4 12	8 0	9 53	
11	4 25	8 48	10 59	
12	5 8	9 36	12 4	♌ 4
13	5 21	10 24	1 M 8	
14	6 4	11 12	2 5	♍ 5
15	6 17	12 0	3 0	
16	7 0	12 M 48	3 43	
17	7 13	1 36	4 20	♎ 6
18	7 26	2 24	4 52	
19	8 10	3 12	5 22	♏ 7
20	8 23	4 0	5 52	
21	9 6	4 48	6 20	
22	9 19	5 36	7 7	♐ 8
23	10 2	6 24	7 55	
24	10 15	7 12	8 50	♑ 9
25	10 28	8 0	9 53	
26	11 12	8 48	10 59	
27	11 25	9 36	12 4	♒ 10
28	0 8	10 24	1 8	
29	0 21	11 12	2 5	♓ 11
30	1 4	12 0	3 0	

USE. The *Sun's Place* is expressed in Signs and Degrees under each Month. On the left Hand of the *Degrees* of the *Sun's Place* stand the *Golden Numbers*, respectively answering to the Days of the *Month*, whereon the *New Moons* happen; when the *Moon's Place* is the same with the *Sun's*. From whence, the Days of her *Age* must be reckoned forward to the Month Day, whereon the *Moon's Place is required*: Adding the *Signs* and *Degrees* gone forward, by the *Moon*, according to the Number of Days of her Age, in the annexed Table. When the Sign and Degree of the *Moon's Place* are found, observe against what *Day of the Month* the same *Sun's Place* stands in the *Table*, and the Moon's *half Time* above the Horizon, will be the same as that *half Day*: known by the nearest Month-Day in Table p. 156, of Sun's Setting, which must be *deducted* from the Time of the Moon's Southing for her Rising, or added thereto for her Setting, at *London*, or in *England*.
In other Parts of the World, use the *Semi-Duration Arc*, according to the *Place*'s Latitude, and Moon's Place or Decln, considered without Latitude. *See Tab. of Semi-Duration Arcs* farther on.

To find the Moon's Place and Rising, July 16, 1760? The Golden No. being 13, stands against 13th *July* at New Moon, when the Sun and Moon's Place will be . . . . 3s 21°
For 3 Days of the Moon add 1 9

Sum 5 0

Or ♍ 0°, to which answers *Aug.* 23, when the Half-Day, (equal the half Continuance of Moon above the Horizon) is 7h 3m which taken from 2h 24m ☽'s Southing, leaves 7h 21m Morning her Rising. And so for other Cases.

HIGH WATER, at the following PLACES, in *Hours* and *Minutes*, before or after the Time of High Water at *London*.
Note, *a* stands for *after*, and *b* for *before*.

Amsterdam,	a 0h 30′	Fowey,	a 3 10	Harwich,	b 3 30	Ostend,	b 2 0	Spithead,	b 3 0
Brest,	a 1 0	Flushing,	b 1 30	Hastings,	b 4 0	Orfordness,	b 4 0	Sheerham,	b 4 0
Bidlington Pier,	a 2 0	Gouries Gut,	b 0 5	St. Helens,	b 5 30	Plymouth,	a 3 10	Tinmouth Haven,	a 0 30
Bridgewater,	a 4 40	Gravesend,	b 1 20	Havre-de-Grace,	b 5 30	Portland,	a 5 50	Tinmouth,	a 3 40
Buoy of Nore,	b 1 30	Gunfleet,	b 4 0	Loo,	a 3 10	Portsmouth,	b 2 0	Torbay,	a 3 40
Calais,	b 3 0	Hartlepool,	a 0 30	Lime,	a 3 50	Rochester,	b 1 20	Topsham,	a 3 50
Dartmouth,	a 3 30	Humber,	a 2 0	Leigh,	b 0 5	Rammekins,	b 1 20	Texel,	a 4 40
Dover,	b 3 0	Hull,	a 3 30	Mountsbay,	a 1 15	Redsand,	b 2 0	Weymouth,	a 4 25
Dieppe,	b 4 0	Harborough	a 3 30	Maze,	b 0 5	Scilly,	a 1 45	Yarmouth Pier,	b 4 40
Exmouth,	a 3 50	Harflew,	a 5 50	Needles,	b 4 40	Shoe Bacon	b 2 0		

EXAMPLE. *To find the Time of High-Water at* Rochester, *on the* 10*th Day of the* Moon's Age.
At *London*, on that Day, it is high Water — 9h 53m
subtract 1 20

High Water at *Rochester* — 8 33
And the like for other Places, by adding or subtracting to or from High Water at *London*.

CHRONOLOGICAL TABLES.

A TABLE, to find the Time of the *Paschal* or *Easter* Full Moon, and consequently *Easter, for ever,* by the Golden Numbers, and Days the *Lunar* Cycle of 19 Years goes forward in any given Period, *New Style.*

Days the Lunar Cycle is gone forward in a given Period.

Paschal Full Ds	Dom. Letter.	GOLDEN NUMBERS. i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv	xv	xvi	xvii	xviii	xix
Mar. 21	C	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26
22	D	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27
23	E	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28
24	F	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29
25	G	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0
26	A	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1
27	B	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2
28	C	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3
29	D	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4
30	E	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5
31	F	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6
Apr. 1	G	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7
2	A	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8
3	B	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9
4	C	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10
5	D	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11
6	E	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12
7	F	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13
8	G	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14
9	A	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15
10	B	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16
11	C	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17
12	D	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18
13	E	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19
14	F	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20
15	G	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21
16	A	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22
17	B	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23
17	B	5	16	27	8	19	0	11	22	3	14	25	7	18	29	10	21	2	13	24
18	C	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24
18	C	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	1[illegible]	25

EXAMPLE. *To find the Full Moon before Easter-Sunday, in the Year 1765?*
Against the Period 1700, in TABLE below stands 1, and the Golden Number for 1765 being 18, against 1, the Days gone forward in that Period, under the Golden Number xviii, in this Table stands *April* 6, in the first Column for Answer. And the Dominical Letter in 1765 being F, reckoning on from *April* 6, to F, *Apr.* 7 is *Easter-Sunday*, and so for other Cases.

NOTE. The Days the Cycle is gone forward, standing under the given Golden Number, and against a certain Month-day, serve for a given Period, according to TABLE below.

A TABLE of the Number of Days, the *New, Full,* or *Quarter* Moons in the *Gregorian* Account, go forward in the Months, or the *Lunar* Cycle, (of 19 Years, or 235 Synodical Months) advances of the Cycle in the Beginning of 1600.

Bissextile Years.	Gregor. Years of Chr.	Lu. Cyc. go forw. Days.	Gregor. Years of Chr.	Lu. Cyc. go forw. Days.	Gregor. Years of Chr.	Lu. Cyc. go forw. Days.	Gregor. Years of Chr.	Lu. Cyc. go forw. Days.	Gregor. Years of Chr.	Lu. Cyc. go forw. Days.	Gregor. Years of Chr.	Lu. Cyc. go forw. Days.
B	1600	0										
	1700	1	2900	6	4100	11	5300	16	6500	21	7700	26
	1800	1	3000	6	4200	12	5400	17	6600	22	7800	27
	1900	2	3100	7	4300	12	5500	17	6700	23	7900	28
B	2000	2	3200	7	4400	12	5600	17	6800	22	8000	2[illegible]
	2100	2	3300	7	4500	13	5700	18	6900	23	8100	28
	2200	3	3400	8	4600	13	5800	18	7000	24	8200	29
	2300	4	3500	9	4700	14	5900	19	7100	24	8300	29
B	2400	3	3600	8	4800	14	6000	19	7200	24	8400	2[illegible]
	2500	4	3700	9	4900	14	6100	19	7300	25	8500	0
	2600	5	3800	10	5000	15	6200	20	7400	25	&c.	
	2700	5	3900	10	5100	16	6300	21	7500	26		
B	2800	5	4000	10	5200	15	6400	20	7600	26		

See the Reason, Page 30, why the Lunar Cycle goes forward in the Months, according to a certain Number of Days, as here inserted.

CHRONOLOGICAL TABLES.

A TABLE, shewing the MOVEABLE FEASTS, by the DOMINICAL LETTER and GOLDEN NUMBER, from 1700 to 1899, according to the *Gregorian* or New Style.

D. L.	GOLDEN NUMBERS.	From Xmas to Sh. Sund.	Shrov. Sund.	Easter Sunday	Rog. Sund.	Asc. Day.	Whit. Sund.	Trin. Sund.	Adv. Sund.
A	3.11.14	6w 0d	Fe. 5	Mar.26	Ap. 30	May 4	May 14	May 21	Dec. 3
	5.8.13.16.19	7	12	Ap. 2	May 7	11	21	28	3
	2.7.10.18.	8	19	9	14	18	28	Jun. 4	3
	1.4.9.12.15	9	26	16	21	25	Jun. 4	11	3
	6.17	10	Mar. 5	23	28	Jun. 1	11	18	3
B	3.11.14.19	6 1	Feb. 6	Mar.27	May 1	May 5	May 15	May 22	No. 27
	2.5.8.13.16	7 1	13	Apr. 3	8	12	22	29	27
	7 10.15.18	8 1	20	10	15	19	29	Jun. 5	27
	1.4.9.12	9 1	27	17	22	26	Jun. 5	12	27
	6.17	10 1	Mar. 6	24	29	Jun. 2	12	19	27
C	3.8.11.14.19	6 2	Feb. 7	Mar.28	May 2	May 6	May 16	May 23	28
	2 5.13.16	7 2	14	Apr. 4	9	13	23	30	28
	4.7.10.15.18	8 2	21	11	16	20	30	Jun. 6	28
	1.9.12.17	9 2	28	18	23	27	Jun. 6	13	28
	6.	10 2	Mar. 7	25	30	Jun. 3	13	20	28
D	14.	5 3	Feb. 1	Mar.22	Ap. 26	Ap. 30	May 10	May 17	29
	3.8.11.19	6 3	8	29	May 3	May 7	17	24	29
	2.5.10.13.16	7 3	15	Apr. 5	10	14	24	31	29
	4.7.15.18	8 3	22	12	17	21	31	Jun. 7	29
	1.6.9.12.17	9 3	Mar. 1	19	24	28	Jun. 7	14	29
E	3.14	5 4	Feb. 2	Mar.23	Ap. 27	1	May 11	May 18	30
	8.11.16.19	6 4	9	30	May 4	8	18	25	30
	2.5.10.13	7 4	16	Apr. 6	11	15	25	Jun. 1	30
	4.7.12.15.18	8 4	23	13	18	22	Jun. 1	8	30
	1.6 9.17	9 4	Mar. 2	20	25	29	8	15	30
F	3.14.	5 5	Feb. 3	Mar.24	Ap. 28	2	May 12	May 19	Dec. 1
	5.8.11.16.19	6 5	10	31	May 5	9	19	26	1
	2.10.13.18	7 5	17	Apr. 7	12	16	26	Jun. 2	1
	1.4.7.12.15	8 5	24	14	19	23	Jun. 2	9	1
	6.9.17	9 5	Mar. 3	21	26	30	9	16	1
G	3.11.14	5 6	Feb. 4	Mar.25	Ap. 29	3	May 13	May 20	2
	5.8.16.19	6 6	11	Apr. 1	May 6	10	20	27	2
	2.7.10.13.18	7 6	18	8	13	17	27	Jun. 3	2
	1.4.12.15	8 6	25	15	20	24	Jun. 3	10	2
	6.9.17	9 6	Mar. 4	22	27	31	10	17	2

EXAMPLE. *What Time do the Moveable Feasts fall in 1762?* The *Dominical Letter* being C, and *Golden Number* 15; *Shrove Sunday* is *February* 21; *Easter*, *April* 11; *Rogation*, *May* 16; *Ascension-Day*, *May* 20; *Whitsunday*, *May* 30; *Trinity Sunday*, *June* 6; *Advent Sunday*, *November* 28; so for other Years.

Note. The above Table will serve from 1900 to 2199, except when the *Easter* Moon falls on a *Sunday*; then *Easter* falls a Week after the Time, by the Tables.

A TABLE, shewing the *Moveable Terms*, from 1700 to 1899.

Easter Term begins.	Ends.	Trinity Term begins.	Ends.
Ap. 12	May 8	May 26	Ju. 14
19	15	Jun. 2	21
26	22	9	28
May 3	29	16	July 5
10	Jun. 5	23	12
Ap. 13	May 9	May 27	Ju. 15
20	16	Jun. 3	22
27	23	10	29
May 4	30	17	July 6
11	Jun. 6	24	13
Ap. 14	May 10	May 28	Ju. 16
21	17	Jun. 4	23
28	24	11	30
May 5	31	18	July 7
12	Jun. 7	25	14
Ap. 8	May 4	May 22	Ju. 10
15	11	29	17
22	18	Jun. 5	24
29	25	12	July 1
May 6	Jun. 1	19	8
Ap. 9	May 5	May 23	Ju. 11
16	12	30	18
23	19	Jun. 6	25
30	26	13	July 2
May 7	Jun. 2	20	9
Ap. 10	May 6	May 24	Ju. 12
17	13	31	19
24	20	Jun. 7	26
May 1	27	14	July 3
8	Jun. 3	21	10
Ap. 11	May 7	May 25	Ju. 13
18	14	Jun. 1	20
25	21	8	27
May 2	28	15	July 4
9	Jun. 4	22	11

Easter Term begins *April* 28, ends *May* 24. *Trinity* Term begins *June* 11, ends *June* 30, for the same Year 1762.

Note, *Easter* Term begins 17 Days, and ends 43 Days after *Easter*. *Trinity* Term begins 5 Days, and ends 24 Days after *Trinity*. Therefore *Easter* Term continues 27, and *Trinity* 20 Days, inclusive.

Emendation. P. 148. For F, (against 4 Years *current* since Chr. O. S. under 700) make FE with the Pen. Same Pa. For FD (against 12 Yrs. bef. Chr. O. S. under 700) make ED.

☞ In the Dom. Letter and Golden No. Tables, O. and N. Style, the Yrs. *since Christ*, were first considered as *compleated*, or 1, 2, 3, &c. Years of Chr. reckoned after compleated, (instead of current) by which the 0 Year was considered Bissextile, fr. the beginning to the End of the 1 Year since the Birth of Christ; the 1st Year from thence to the *End* of 2d, &c. whereby 1st Year *before Christ* was considered 1st after Bissextile, which *is Bissextile*, considering the Years since Chr. *current*, as they are. Therefore, to find the D. Let. or Golden No. for ... before Chr. 1 must be deducted from the true Year, *before Christ*, and then find them, in the Tables from the *Date* remaining; bec... before Chr. should stand in the Place of 0, Year; 2 in the Place of 1, Year; 3 in Place of 2 Year, &c. in the *Tables for Years* ... *Christ*.—While the similar Tables, for Years since Christ, are used as they stand.

CHRONOLOGICAL TABLES.

A TABLE, shewing, at Sight, the MOVEABLE FEASTS, and TERMS, for ever, by the DOMINICAL LETTER, and GOLDEN NUMBER, according to Old Style.
Of Use in HISTORY and CHRONOLOGY.

D. L.	GOLDEN NUMBERS.	From Xmas to Sh. Sund.	Shrove Sund.	Easter Sunday	Rog. Sunday	Ascen. Day.	Whit-Sunday	Trin. Sunday	Advent Sunday	Easter Term begins.	Ends.	Trinity Term begins.	Ends.
	2.5.13.16	6w 0d	Feb. 5	Mar. 26	Apr. 30	May 4	May 14	May 21	Dec. 3	Apr. 12	May 8	May 26	Jun. 14
	7.10.15.18	7	12	Apr. 2	May 7	11	21	28	3	19	15	Jun. 2	21
A	1.4.9.12	8	19	9	14	18	28	Jun. 4	3	26	22	9	28
	3.6.11.14.17	9	26	16	21	25	Jun. 4	11	3	May 3	29	16	July 5
	8.19	10	Mar. 5	23	28	Jun. 1	11	18	3	10	Jun. 5	23	12
	2.5.13.16	6 1	Feb. 6	Mar. 27	May 1	May 5	May 15	May 22	No. 27	Apr. 13	May 9	May 27	Jun. 15
	4.7.10.15.18	7 1	13	Apr. 3	8	12	22	29	27	20	16	Jun. 3	22
B	1.9.12.17	8 1	20	10	15	19	29	Jun. 5	27	27	23	10	29
	3.6.11.14	9 1	27	17	22	26	Jun. 5	12	27	May 4	30	17	July 6
	8.19	10 1	Mar. 6	24	29	Jun. 2	12	19	27	11	Jun. 6	24	13
	2.5.10.13.16	6 2	Feb. 7	Mar. 28	May 2	May 6	May 16	May 23	28	Apr. 14	May 10	May 28	Jun. 16
	4.7.15.18	7 2	14	Apr. 4	9	13	23	30	28	21	17	Jun. 4	23
C	1.6.9.12.17	8 2	21	11	16	20	30	Jun. 6	28	28	24	11	30
	3.11.14.19	9 2	28	18	23	27	Jun. 6	13	28	May 5	31	18	July 7
	8	10 2	Mar. 7	25	30	Jun. 3	13	20	28	12	Jun. 7	25	14
	16	5 3	Feb. 1	Mar. 22	Apr. 26	Apr. 30	May 10	May 17	29	Apr. 8	May 4	May 22	Jun. 10
	2.5.10.13	6 3	8	29	May 3	May 7	17	24	29	15	11	29	17
D	4.7.12.15.18	7 3	15	Apr. 5	10	14	24	31	29	22	18	Jun. 5	24
	1.6.9.17	8 3	22	12	17	21	31	Jun. 7	29	29	25	12	July 1
	3.8.11.14.19	9 3	Mar. 1	19	24	28	Jun. 7	14	29	May 6	Jun. 1	19	8
	5.16	5 4	Feb. 2	Mar. 23	Apr. 27	1	May 11	May 18	30	Apr. 9	May 5	May 23	Jun. 11
	2.10.13.18	6 4	9	30	May 4	8	18	25	30	16	12	30	18
E	1.4.7.12.15	7 4	16	Apr. 6	11	15	25	Jun. 1	30	23	19	Jun. 6	[illegible]
	6.9.14.17	8 4	23	13	18	22	Jun. 1	8	30	30	26	13	July 2
	3.8.11.19	9 4	Mar. 2	20	25	29	8	15	30	May 7	Jun. 2	20	9
	5.16	5 5	Feb. 3	Mar. 24	Apr. 28	2	May 12	May 19	Dec. 1	Apr. 10	May 6	May 24	Jun. 12
	2.7.10.13.18	6 5	10	31	May 5	9	19	26	1	17	13	31	19
F	1.4.12.15	7 5	17	Apr. 7	12	16	26	Jun. 2	1	24	20	Jun. 7	[illegible]
	3.6.9.14.17	8 5	24	14	19	23	Jun. 2	9	1	May 1	27	14	July [illegible]
	8.11.19	9 5	Mar. 3	21	26	30	9	16	1	8	Jun. 3	21	10
	5.13.16	5 6	Feb. 4	Mar. 25	Apr. 29	3	May 13	May 20	2	Apr. 11	May 7	May 25	Jun. [illegible]
	2.7.10.18	6 6	11	Apr. 1	May 6	10	20	27	2	18	14	Jun. 1	[illegible]
G	1.4.9.12.15	7 6	18	8	13	17	27	Jun. 3	2	25	21	8	[illegible]
	3.6.14.17	8 6	25	15	20	24	Jun. 3	10	2	May 2	28	15	July 4
	8.11.19.	9 6	Mar. 4	22	27	31	10	17	2	9	Jun. 4	22	11

A *General* TABLE of the SUN'S *Rising* and *Setting*, for *England* and *Ireland*, NEW STYLE. To be used with *Table*, Page 153.

Days	January.		February.		March.		April.		May.		June.		July.		August.		September		October.		November		December	
	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.	rises.	sets.
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
3	8 3	3 57	7 23	4 37	6 29	5 32	5 27	6 34	4 32	7 29	3 50	8 10	3 46	8 14	4 22	7 37	5 17	6 42	6 16	5 43	7 15	4 44	7 59	[illegible]
6	8 1	3 57	7 18	4 43	6 23	5 38	5 21	6 40	4 27	7 34	3 47	8 13	3 48	8 12	4 27	7 32	5 23	6 36	6 22	5 37	7 20	4 39	8 2	3 58
9	7 58	4 2	7 13	4 48	6 17	5 44	5 16	6 45	4 22	7 39	3 46	8 14	3 51	8 9	4 31	7 28	5 29	6 30	6 28	5 31	7 25	4 34	8 4	[illegible]
12	7 55	4 5	7 8	4 53	6 11	5 50	5 10	6 51	4 17	7 44	3 45	8 15	3 54	8 6	4 36	7 23	5 35	6 24	6 53	5 26	7 31	4 28	8 6	[illegible]
15	7 51	4 9	7 2	4 59	6 5	5 56	5 4	6 57	4 13	7 48	3 44	8 16	3 57	8 3	4 42	7 17	5 41	6 18	6 39	5 20	7 36	4 24	[illegible] 7	[illegible]
18	7 48	4 12	6 56	5 5	5 59	6 2	4 58	7 3	4 8	7 53	3 43	8 17	4 0	8 0	4 47	7 12	5 47	6 12	6 45	5 14	7 41	4 19	8 8	[illegible]
21	7 44	4 16	6 50	5 10	5 53	6 8	4 53	7 8	4 4	7 57	3 43	8 17	4 4	7 56	4 53	7 6	5 52	6 7	6 51	5 8	7 45	4 15	8 8	[illegible]
24	7 39	4 21	6 45	5 16	5 47	6 14	4 48	7 13	4 0	8 1	3 43	8 17	4 8	7 52	4 58	7 1	5 58	6 1	6 55	5 2	7 49	4 11	8 8	[illegible]
27	7 34	4 26	6 39	5 21	5 41	6 20	4 42	7 19	3 57	8 4	3 44	8 16	4 12	7 48	5 4	6 55	6 4	5 55	7 2	4 57	7 52	4 8	[illegible] 7	[illegible]
30	7 30	4 30			5 35	6 26	4 37	7 24	3 54	8 7	3 45	8 15	4 17	7 43	5 9	6 50	6 10	5 49	7 7	4 52	7 56	4 4	[illegible] 5	[illegible]

N. B. *The Time of the* Sun's Setting, *in the* above Table, *being* doubled, *will shew the Length of that Day, in the Year.*

REMARKS

REMARKS *on the* ÆRAS, *or Points of* TIME.

THE most famous *Æra* is that of *Jesus Christ*, beginning at the *Kalends* of *January*, immediately following the *Birth*.

Though this *Æra* is generally received by *Christians*, yet the *English* and *Irish* used an *Æra* later by a whole Year in all public and *ecclesiastical* Writings, before the *Alteration of the Style*. They did not begin the Year with the 1st of *January* following the *Nativity*, but with the 1st of the *Conception*, or Incarnation, observed on the 25th of *March*; and therefore the *English* reckoned from the *Feast of Lady-day*, 1748, that there were compleated 1747 Years. But, from the *Birth* of our Lord to the *Feast* of the Nativity, in the Year 1747, they numbered only 1746 Years *elapsed*; whereas all the Rest of the *Christian World* reckoned 1747.

Dionysius Minor, Author of the *Christian Æra*, made the *Conception* of *Christ* to be on the 8*th* of the *Kalends* of *April*, on the first Year of this *Æra*, and born the Winter following, at the End of the 46th Year of the Reformation of the *Calendar* by *Julius Cæsar*.

This Way of *Computation* was universally accepted, at first, but *universally* receded from by Degrees; and did not take Place in *England*, and some other Places, before the End of the *old Style*.

The COMMON Opinion is, that *Christ* was born the Winter preceding the Time in which *Dionysius* reckoned the Conception; yet the *English* and the Rest of the *Christian* World, agreed about the Time since his Birth for the greater Part of the Year; but for three Months, from the *Kalends* of *January* to the 8th of the *Kalends* of *April*, they wrote one Year less.

CONTROVERSIES *about* ÆRAS.

There are many *Controversies* about the *Æra* of CREATION, among the *Chronologists*, *(and always will)* some affirming the World to be *created* 3950 Years before *Christ*; others affirm 398c. The *Greek*-Church, and *Eastern* Emperors *Æra* of Creation was 5509 Years before *Christ*. But the *Chinese* Date of the World is much older; and such *chronological* Disputes will never be settled.

The antient *Æra* of the *Olympiads* begun 775 Years before *Christ*, on the *Kalends of July*, according to some; but 776 according to the *Greeks*, who yet make the Year of the *Julian* Period 3938.

The *Æra* of the Building of *Rome* is either the *Varronian*, 752 Years, or the *Capitolian*, beginning *April* 21, 751 Years before *Christ*.

The *Æra* of *Nabonassar*, famous among Astronomers, began the 26*th of February* of the *Julian* Year, reckoned backward to 746 before *Christ*: That Day being the 1st of the *Egyptian* Year. *Ptolomy*, and, after him, *Copernicus*, computed the *Places* of the *cœlestial* Bodies from it.

The *Æra* of *Alexander* begins 324 Years before *Christ*, *November* 12, being on a *Sunday*, and according to Chronology, which was also the 1st Day of the *Egyptian* Year. Between the *Æra* of *Nabonassar* and *Alexander*, there are 424 *Egyptian* Years. The *Abissines* reckoned by the *Æra* of *Martyrs*, called *Dioclesian*, beginning *August* 29, in the Year of *Christ* 284.

The *Turks* and *Arabians Æra*, call'd *Hegira*, takes its Beginning from *Mahomet*'s Flight, *July* 16, *Anno Christi* 622.

The *Persian Æra* is called *Jesdegird* begins *June* 16, *Anno Christi* 632.

The *Julian Period*, containing all other *Æras*, has been described, Page 146; which *Æras*, when reduced to it, differ, according to different *Authorities*.

The *Antients* distinguished their *Time* by other Revolutions; such as the *Jubilee* of 49 or 50 Years; an Age of 100; and an *Olympiad* of 4 Years, among the *Greeks*, beginning at the *New Moon*, next after the *Summer* Solstice, 775 Years before *Christ*.

The *Persians* observe the *Egyptian* Account of 365 Days in a Year to this Day. In which Reckoning the *Equinoxes* and Seasons move forward through the Year in the Space of 1506 *Egyptian Years*, 4 *Hours*, 27 *Minutes*, 8 *Seconds*, according to the *Newtonian* Mean *Solar* Year, when the same Season begins again. This Year is extremely convenient for *Astronomical Computation*; because of no Motion to be added for *intercalary* Days in the Reckoning; there being none of those Days taking Place.

The *Difference* of a Year, or more, between some of these *Æras*, and those we have given, at Page 146, *(which we find disputable)* we leave to be *settled* by *Chronologists*, making this Subject their chief Study; as there is no Likelihood for *Men of Science* to agree exactly in these Matters, *not capable of Demonstration*.

The *Week-day* correspondent to the *Month-day*, for the reputed Year, many Years before *Christ*, is another *Obstacle* lying in the Road to *Truth*, in chronological Computation. For, before the Time of *Julius Cæsar*, the Form of the Year, or *Year of Confusion*, was never *exactly* and regularly settled, by which it will be hard to know the Week-day, on which every successive Year, since Creation, began; as likewise the *Week-day*, correspondent to the *Month-day of any Year*, since Creation: The same depending on the settled Form, or known Changes, of the Year, from some *particular Date*. The Antient *Week* and *Month*-Days, before *Christ*, the most certainly known, are reduced to the *Julian* Form of Reckoning, whereby they become intelligible.

WHEN *Julius Cæsar* reformed the *Calendar* in the 45th Year before *Christ*, he ordered that the 1 Day of the *Julian* Year, should begin on *Jan.* 1, immediately after the old *Roman* Year of *Confusion*, which happened, according to Chronology, on a *Friday*. Now (*by Tab. p.* 148.) the Dom. Let. for 45 Years before Christ, (deducting 1 from 45 to find it) was D, old Style. Whence (by *Tab. p.* 149.) the 1st of *Jan.* in that Year was on a *Friday*, agreeing with Chronology. Likewise, we find, on *Retrospection*, that 28th *May*, in the 585 Year before *Christ*, being Leap-Year, was on a *Wednesday* and not on a *Monday*, when the Battle between the *Medes* and *Lydians* was decided. Our *Mistake* against *Ferguson's* Astronomy, at *p.* 149, we therefore *freely give up to Truth and Justice*. At the same Time we observe, if his *Æra*, 44 Years bef. Chr. *be true*, when the *Calendar* was corrected, that *Jan.* 1st happened, by our and his *Tables*, on a *Sunday*, and not on a *Friday*, according to Chronology. That the 24th, and not 23d *Feb.* (*see p.* 10, Ferguson's *Appendix*) is on the 6th of the *Kalends* of *March* — and 24 and 25th of *Feb.* (not 23 and 24) are reckoned the same Day, in *Bissextile*.

p. 149
45 170

☞ *Mistakes in the Æras or Dates of Chronology, may in general be rectified by making them agree with the Week-Days to which they are fixed; the Week-Day being a material Circumstance in all Chronologies and Histories of* EVENTS.

REMARKS *on the* NATURE *and* MEASURE *of* TIME.

TIME, by our *Conception*, proceeds with a constant equable Flux, or uniform *Succession*. The Measure of which must therefore be referred to Motion; and that of the apparent uniform Motion of the *fixed Stars* is best. But the variable Motion of the *Sun* and *Moon* have, by the Consent of all Ages, (as more conspicuous and observable than that of the *Planets* and *Stars*) been made Choice of for this Purpose; which Bodies seem to have been intended by the *divine Architect*, besides their other Uses, for *perpetual Chronometers*, to distinguish and mark out the *Seasons*, *Days*, and *Years*, as they are.

Astronomers observe that the *Days*, and therefore the *Hours*, and *Minutes*, are *unequal*, and that by the Earth *slackening* her Pace, and sometimes *quickening* it again in her Orbit; besides her uniform Rotation from *West* to *East*, the same Way, on her *Axis*, in a Day's Time. This they infer from the Sun's different apparent Motion, through the same Length of Year, nearly.

Therefore, to measure Time, or refer it to *one Standard* of *uniform Motion*, (as they imagine) they have fixed the Length of the *solar Year* (or that Time wherein the Sun and Earth finish their several Positions with each other, and begin again) to the constant Period of $365^d\ 5^h\ 48^m\ 57^s\ 39^{th}$, &c. according to Sir *Isaac Newton*; but different by others.

But

REMARKS *on the* NATURE *and* MEASURE *of* TIME.

But one Way or the other, this Length of the Year is no more certain or permanent than the *mean Length of a Day*. Since, in this Computation, they divide the Distance of Time between any two distant *Equinoxes*, or *Solstices*, observed, by the Number of Revolutions between those Observations, whereby they but determine the *mean Length* of the *variable solar* Period, which they afterwards suppose permanent or equal.

To do which, as Sir *Isaac Newton* went no farther back than 20 Years, betwixt the first and last Observation, he could not determine the Length of the mean Year to so great an *Exactness*, as if he had gone as far back into Antiquity, as *Ptolomy*'s Time, or before, for his *first Observation*. For the *mean* solar Year this Way determined, by the great Distance of Time divided by the great Number of Revolutions, would have come so near the Truth *(except an Acceleration of the mean Motion of the Sun or Earth be supposed)* that if there had been a considerable Error committed in the Time of the *1st Observation*, or elsewhere, yet, it would have became insignificant for one Year, by its Division into so a great Number of Parts or Revolutions.

Hence, $365^d.24234027 : 365^d :: 12^s : 11^s.99203814$, &c. $= 11^s\ 29^\circ\ 45'\ 40''\ 7'''$, &c. Sun's Motion in 365 Days, according to Sir *Isaac Newton*. From whence the mean diurnal Motion in the Ecliptic $= 59'\ 8''$, &c. (as before observed in the *Tables)* whereas the apparent or real Motion amounts to $61'$ sometimes, and at other Times scarcely to $57'$: The *mean* and *true* Time being proportional to the *mean* and *true* Motions.

But, considering the *annual* Precession of the *equinoctial* Points at the mean Rate of $50''$, according to some, but different by others, the Variation of the *Ecliptic's Obliquity*, the different Distances of the *observed Equinoxes*, or *Solstices*, by which the Solar Year is differently determined, ASTRONOMICAL TABLES, formed according to these *different Principles* (as has been the Custom) must vary *more* or *less* from the Truth in Computation; verifying Dr *Halley*'s Observation to his *Friend* that "*all Astronomical Tables are made to be mended.*" And the present superior *Accuracy* we pretend to, in our Tables, is by a Comparison with, and Improvement of, the latest and *best Authorities*.

Of REST *and* MOTION *of* BODIES, *and of* ANTIENT *and* MODERN HYPOTHESES.

RELATIVE *Rest* we observe daily in the Masses of inanimated *Matter* about us; but ABSOLUTE REST in any Thing we observe, is as hard to distinguish, as an *absolute Vacuum* in infinite Space.

Dr. *Bradley*, by his more diligent and correct Observations of the Heavens, was the first who discovered the *Aberration of the fixed Stars* (caused by the Motion of Light and of the Earth in its Orbit) who has also made a Discovery of another apparent Motion among the *fixed Stars*, in his Letter to the *Earl of Macclesfield*. And it has been the Opinion of the *antient*, as well as it is now of the *modern*, Astronomers, that different Worlds, or distant *Systems*, have a relative Motion among one another, at the same Time they are relatively moving forward *(perhaps in Orbits round a central World)* in infinite Space. This Notion of a *Plurality* of Worlds has prevailed ever since the Time of the *Pythagoreans*, who maintained *(as we now do)* the Probability of the *several Planets* being inhabited by a particular Kind of *Beings*, suited to those Regions. Who likewise maintained that the Planets were retained in their Orbits by the Power of Gravity. *That each Planet moved round its Orbit like a Stone whirled round at the End of a String, by* Centripetal *and* Centrifugal *Forces*. And *Lucretius*, taught by *Democritus*, supposed Worlds without Number, in the infinite Space, counterpoising each other, by some general *Law of Gravitation*. That if Bodies were bounded, those, within the *Limit*, would, by the Attraction of one another, in Time, unite in the middle Space.

And herein it is observable, that *Limits* of Space appear as *impossible* to Conception, as the *Limits* of Time, or of Existence. For, there is no Thought can imagine when *Time and Existence were not*; nor can Imagination represent, to a *rational* Mind, *a Possibility, when Time and Existence shall be no more*; except in the Sense of all Things (after a Dissolution of our Earth and System) being swallowed up in an eternal Duration and Immensity of *Existence*, in their several *new Modes*. Therefore, an ETERNAL and INFINITE EXISTENCE ARE OF UNAVOIDABLE NECESSITY. But the *infinite Succession of Time*, and the *Points* of it, from whence all *new Forms of Things, Beings*, and their astonishing *Changes*, take their Place and Effect, who but an INFINITE GREAT BEING, *(eternally existing before all Worlds)* can comprehend!

The Ancient *Astronomers* first imagined, that the *Cœlestial* Bodies had a circular and equal Motion round the Body which they supposed at Rest, but not finding this *Circular Hypothesis* to agree with their Observation (the Sun spending near eight Days more in the Northern, than in the Southern Semi-Circle of the Ecliptic) to reconcile Appearance better to Observation, fixed the Sun, or Earth, at Rest, 3450 such Parts from the Center of the supposed Circular Orbit, as the Radius of it is 100000, which Distance from the Center is called *Eccentricity*, whence they readily calculated the Sun's Place, at any Time. This *Theory*, though agreeing pretty well for the Place of the Sun, the Motion of other Planets could not be accounted for by it: Therefore it was changed by *Kepler*, for the Elliptical Theory; which supposes the Sun in the lower *Focus* common to the Elliptical Orbits of all the Planets, with a rotary Motion only about his own *Axis*, they circulating round him, and describing constantly *equal Areas in equal Times (or Areas proportional to the Times) by Rays drawn from the Sun, to each respective Planet*. By the same Hypotheses are represented the Motions of all the Secondary Planets round their Primary ones, placed in the lower *Focus* of each Secondary's Orbit: And this *Hypothesis* answers to the Appearances in the Heavens beyond all others hitherto invented; though *Kepler* himself at first doubted whether some Orbits vary from true *Ellipses*: Thinking it is not improbable that some might have a Form like the Section of an *Egg*, by the Force of Gravity dilating one Part of the Orbit more than another. But this Theory follows the Track of the first *Circular Theory*, which supposed the SUN at Rest in the Center of the planetary Orbits, and Planets moving circularly round Him, whereby they must describe equal Areas in equal Times; as they are now found to do in the Elliptical *Theory*, by Observation.

The Sun's *least* apparent Diameter in *Apogee* has been observed $31'\ 29''$, and his greatest in *Perigee* $32'\ 33''$, by which it should result, that the Sun's greatest and least Distances are as 1953 to 1889, as 101661 to 98339 *(vid. Keil's Astron. p. 277)* and the Eccentricity only 1661 of such Parts, as the Radius of the *Circular* Orbit, Sem. Transf. (or mean Dist.) of the Elliptical Orbit is 100000: But the antient Eccentricity 3450 is above double 1661, from whence the *Circular Theory* was long ago concluded to be false. For, admitting but 1725, one half of the ancient Eccentricity, it would better agree with the Sun's apparent Diameters observed: But then would not, so well as the *whole*, account for the Appearances of the Sun's unequal Motion round the Year. And (as the *Ancients* did) making the Center of the Circular Orbit, the Center of equal Motion, 1725 Eccentricity will not account for the *annual* Inequalities. For the *Prostaphæreses*, or Differences between the Sun's mean and true Places are thus twice as much as what they will amount to with this half of ancient Eccentricity. This *Defect* of *Eccentricity* of the Circular Orbit was afterwards nearly compensated for, by placing half of it each Way from the *Orbit*'s Center, and making the Center of equal Motion at the contrary Extreme to that where is placed the Sun, in the elliptical Orbit, which is supposed, by *Ward* and *Bullialdus*, similar to the Center of equal Motion in the Circular Theory. Mr. *Street*'s Eccentricity to this *Theory* of the Earth's Motion is 1732, Mr. *Flamsteed*'s 1692, *Mayer*'s 1680, *Morris*'s 1683, Our's 1685, which make a small Difference in finding the Sun's true Place from his *Mean*; nor is this Difference likely to be adjusted, while different *Observators* of the Heavens, like different *Surveyors* of the same GENTLEMAN'S ESTATE, vary, in their Quantities, from one another.

Kepler having observed, That the *Squares of the Periodical Times of revolving Bodies, are as the Cubes of the Distances from the Centers of the Orbits, about which they are supposed to perform their equal Motions,* (i. e. *as the Cubes of the mean Distances from the Body about which they revolve.)* This UNIVERSAL *Theory* of MOTION, examined and confirmed by Sir *Isaac Newton*, and verified by Observation itself, is only contradicted by supposing the Sun's Motion, and the Earth at Rest.

PRACTICAL

PRACTICAL QUESTIONS IN CHRONOLOGY answered.

Of USE in HISTORY.

QUESTION I.

ANY Year, Month, and Day of the Month, being given, to find the Day of the Week, correspondent?

EXAMPLE. What Day of the Week was the 12th of *March*, in the 4th Year before the reputed Year of *Christ*, the Day wherein the *Eclipse* of the Moon happened, a little before the Death of King *Herod*, at the *real* Birth of *Christ*.

By *Tab.* p. 148, the *Dominical Letters*, for the Year, are found, at Sight, to be BA, which last Letter, A, is used after the 24th of *February*. Consequently by *Tab.* p. 149, *March* 12th, that Year, was on a *Sunday*, required.

QUESTION II.

The 1st, 2d, 3d, or 4th Week-Day (Sunday, Monday, Tuesday, &c.) being given in any Month of a given Year, to find from thence the Day of the Month?

This being the Reverse of the former Question is answered from the same *Tables*, directly, at Sight.

QUESTION III.

The Day of the Month that Easter *falls on, in any Year, being given, to find in what Years it shall happen so again, or has so before happened viz. on the same Day of the Month, either according to* Old *or* New Style?

EXAMPLE. Let the 25th of *March* be the Time of *Easter* happening, when, according to the Proverb, *My Lord falls in my Lady's Lap?* Here, *March* the 25th being on a *Sunday*, the *Dominical* Letter, by *Tab.* p. 149, will be always G, for *Old* or *New Style*.

Then, by *Tab.* p. 155, find *March* 25th for the Time of *Easter* happening, against the Dominical Letter G, *New Style*, and you will find 3. 11. 14. for the Golden Numbers, standing against the Time, when *Easter* can possibly happen, with the *Dominical Letter* G, for that Time, *New Style*.

In *Old Style*, it happened when the *Golden Numbers* were 5. 13. 16. and *Dominical* Letter G (*See Tab.* p. 156). Now, a Dominical Letter *Cycle* is 28 Years, and a Golden Number Cycle, 19 Years, (in which Periods the Dominical Letters and Golden Numbers return to the same Order, O S.) therefore 28 by 19 produce 532 Years, called the *Dionysian* Period, being the Cycle after which *Easter*, and all the *Moveable Feasts*, began and followed the same Order, again, *Old Style* But, this Order is *interrupted* in the *New Style*, by the Day reckoned *less* in every succeeding odd hundredth Year, than is reckoned by the *Old Julian Account*, and there will be *intermediate* Years, in *both Styles*, wherein the Golden Number and Dominical Letter will happen the same over again, before the Expiration of the said *Dionysian Period*; because of the Rotation of 7 Letters 4 Times in the 28 Year-Cycle. For, by *Tab.* p. 150, the Years when the Golden Numbers are 3. 11. and 14. are as follows.

Golden Number 3.

	1769 . .	1807 . .	1902 . .	2016
	88	26	21	G. 35
Examine these		45	40	54
Years by Dom.		64	59	73
Let. Tab. for		G. 83	78	G. 91 &c.
N. S. p. 149			97	

Golden Number 11.

	1777 . .	1815 . .	1910 : :	2005
	96	34	29	24
Adding 8		53	48	43
to the		72	67	62
former.		91	86	81
				99 &c.

Golden Number 14.

	1780 . .	1818 . .	1913 . .	2008
	99	37	32	27
Adding		56	G. 51	G. 46
3 *to the*		75	70	65
former.		G. 94	89	84
				2102

☞ *In this Manner are the Years backward examined for N. S. by Centuries.* And likewise the Years backward or forward, for O. S. are thus examined, correspondent to the Golden Numbers 5. 13. 16. by the Dominical Letter Table, Old Style, at p. 148, for any Years (before or since 1759) to which the said Golden Numbers belong.

According to N. S. ~~*Lady-Day*~~ Easter *falls on March* 25, in the Years 1883, 1894, 1951, 2035, 2046, 2091, &c. from above.

QUESTION IV.

A LADY *was born on an* Ash-Wednesday, 23 February, *N. S. and was under* 30 *Years of Age*, 1759, *required her Age?*

By *Perpetual Time-Tables*, (see farther on) When *Ash-Wednesday* was on the 23d of *February Easter* fell on *April* 10. And, by *Tab.* p. 155, the *Dominical Letter* B, and Golden Numbers 7. 10. 15. 18. when *Easter* can so happen.

Now, by examining the *Dates* for those Golden Numbers, from *Table*, p. 150, between 1729 and 1759 (the Difference 30 Years, being above the Age) and that Dominical Letter for those *Dates*, by *Tab.* p. 149, You will find only the Year 1735, for the Time of her Birth, when the Golden Number was 7, and Dominical Letter B. Consequently, *the Lady's Age is* 24 *Years, required.*

QUESTIONS *in* CHRONOLOGY *answered.*

QUESTION V.

A PERSON *above* 58 *Years of Age, in the Year* 1759, *was born on a* Friday, July 14, *about the Year* 1700, Old *or* New *Style: Required his Age?*

The *Dominical* Letter, according to *Old* or *New Style*, by *Tab.* p. 149, was A; the *nearest* Year to which 1699, *O. S.* or 1702, *N. S.* When the Dominical Letter was A, for both *Styles*, by *Tab.* p. 148, and *Tab*, p. 149. Whence, his *Age*, in 1759, must be 60, according to *Old Style*, or 57, according to *New*, therefore his Age is 60, required.

In the 1 *Year of the reputed Birth of* Christ, *the Golden Number was* 2, *the Cycle of the Sun* ~~9~~ 10, *and Roman Indiction* ~~3~~ 4, *Year of the* Dionysian *Period* 457, *of the* Julian *Period* 4713. Hence, the Reason of the RULES, p. 146.

QUESTION VI.

The Cycles of the Sun *and* Moon *being given, to find the Year of the* Dionysian *Period, according to* Old *Style?*

RULE. Multiply the Cycle of the Sun by 57, and the Cycle of the Moon, or Golden Number, by 476; divide the *Sum* of the Products by 532, the Remainder, after the Quotient, will be the Year of the *Dionysian* Period, required.

EXAMPLE. The Golden Number is 1, and Cycle of the Sun 9, at the reputed Birth of Christ, to find the Year of the *Dionysian* Period, at that Time?

476
1 Golden Number, or Cycle of the Moon.
———
476
513
———
532)989(1
457 Remainder, *Dionysian* Period, required.

57
9 the Cycle of the Sun.
———
513

QUESTION VII.

The Cycle of the Sun, Moon, *and* Indiction, *being given to find the Year of the* Julian *Period, according to* Old Style?

RULE. Multiply the Number 4845 by the Year of the Cycle of the *Sun*, the Number 4200 by the Year of the Cycle of the *Moon*, and the Number 6916 by the Year of the *Indiction Cycle*: Divide the *Sum* of these Products by 7980 (the Number of Years in the *Julian* Period), and the *Remainder*, after the Quotient, will be the Year of the *Julian* Period, *required.*

EXAMPLE. To find the Year of the *Julian* Period, at the reputed Birth of *Christ*, when the Cycle of the *Sun* was 9, the Cycle of the *Moon*, or Golden Number, was 1, and the *Indiction* 3?

4845
9 Cycle ☉.
———
43605

4200
1 Cycle ☽.
———
4200

6916
3 Indiction.
———
20748
4200
43605
———
7980)68553(8
63840
———
Remainder 4713 Julian Period required.

QUESTION VIII.

To find the Year of the Dionysian *Period, according to* Old Style, *for any Year before or since* Christ?

RULE I. Add 75 (the Complement of 457 to the whole Period 532) to the Number of Years before Christ, and divide that Sum by 532, and subtract what remains from 532, and the last *Remainder* will be the Year of the *Dionysian* Period, for the Number of the Year *before Christ*, required?

N. B. If the Sum of 75, *and the Years before Christ, is less than* 532, *subtract that Sum from* 532, *and the Remainder will be the Year of the Period, required.*

RULE II. Add 457 to the Number of Years since Christ, and divide that Sum by 532, and the Remainder will be the Year of the *Dionysian* Period, for the Year, *since Christ*, required.

N. B. If the Sum of 457, *and the Years since Christ, is* less *than* 532, *that Sum will be the Year of the said Period?*

EXAMPLE I. 1000 Years before Christ.
+75
———
532)1075(2
1064
———
—11
532
———
Remainder 521 Year of the *Dionysian* Period, required.

EXAMPLE II. 2000 Years since Christ.
+457
———
532)2457(4
2128
———
Remainder 329 Year of *Dionysian* Period, required.

QUESTION IX.

The Year of the Dionysian *Period being given to determine from thence the Year before or since Christ?*

This being the Reverse of the former Question, let the *Dionysian* Period be 329, some Year since Christ, or 521, some Year before Christ.

QUESTIONS *in* CHRONOLOGY *answered.*

EXAMPLE.

—521	Number *Dionysian* Period before *Christ.*	329	No. Period since *Christ.*
532	Number of the wh. Period.	+75	Years since *Christ* to Beginning of the 1st Period.
11	Yrs from Begins. of that Period before *Christ.*	404	Years since *Christ,* when Period was 329.
457	No. Period the Yr. bef. *Christ.*	Add 532	continually.
Sum 468	Years before *Christ,* when Period was 521.	936	Years since *Christ,* when Period was 329.
Add 532	continually.	532	
1000	Years before *Christ,* when Period was 521, &c.	1468	Years since *Christ,* when Period was 329.
		532	
		2000	Years since *Christ,* when Period was 329, &c.

N. B. *In the foregoing Example,* before Christ, 1 *should be added to the* Result, *making* 522, *or else* 1 *should have been subtracted from* 1000, *the Yr. before Christ, for the Result of this Operation, then* 522, *to agree with Chronology.* See our *Chronological Scale,* farther on. p.170

QUESTION X.

To find the Year of the Julian *Period, for any Year before or since* Christ?

RULE I. The Number of Years before *Christ,* subtracted from 4714 *(the Number of the Period, in the 1st Year of the reputed Birth of Christ)* the Remainder will be the Year of the *Julian* Period for the Year *before Christ,* required.

RULE II. The Number of Years, *since Christ,* added to 4713, the Number of the Period the Year before Christ, the Sum will be the Year of the *Julian* Period, for the Year, *since Christ,* required.

EXAMPLE I.

4714 Year of the Period in 1st Yr. bef. *Christ.*
—1759 Years before *Christ.*

2955 Year of the Period, *required.*

EXAMPLE II.

1760 Years since *Christ.*
4713 Year of the Period at *Christ.*

6473 Year of the Period, *required.*
N. B. 7980 the *whole Period.*

QUESTION XI.

To find the Year before or since Christ *correspondent to the given Year of the* Julian *Period?*

This QUESTION is the *Reverse* of the former.

RULE I. The given Year of the *Julian* Period must be subtracted from 4714 for the Year *before Christ.*

RULE II. 4713 must be subtracted from the given Year of the *Julian* Period for the Year since *Christ.*

EXAMPLE. The given Years of the *Julian Period,* are 2955 . . . . and 6473, required the Years of *Christ?*

subtracted 4714 ... subtracted 4713

Remainder 1759 Yr *before* Christ, reqd. Rem. 1760 Year *since* Christ, required.

N. B. If the Number of the Julian *Period is equal to, or less than* 4713, *the Year is before, if greater, since* Christ.

QUESTION XII.

A Person since the Year 1740 *said, that* 49 *Times the Years of his Age was equal to the Date of the Year on which he was born: What Age was he?*

PUT x for the Years of the Person's Age. Then $49x=1758-x$. By *Supposition.* But $49x+x=1758$, or $x=\frac{1758}{50}=35\frac{8}{44}$ Years of his Age. But this Age being subtracted from 1758 can leave no whole Number for the *Date:* whence it could not be 1758 to which his Age reckoned. Let $y=$ the *Date,* then $x=\frac{y}{50}$; here $y=1750$, &c. For the Time to which his Age was reckoned, being divisible by 50. Whence $\frac{1750}{50}=35$, his Age, and 1715 was the Date of his *Birth,* required.

A GENERAL PROPOSITION.

To find a whole *Number, which being divided by other given* whole *Numbers, given* whole *Numbers shall remain.*

EXAMPLE. To find a *whole* Number, which being divided by 2, 3, 4, 5, and 6; 1, 2, 3, 4, and 5, shall respectively remain; but being divided by 7, Nothing shall remain.

AXIOM. *Any whole Numbers being subtracted from any other* whole *Numbers, a* whole *Number, or Nothing, shall remain.*

Conditions 1. 2. 3. 4. 5. 6.

Put $x=$ the *whole* Number, sought: Then, $\frac{x-1}{2}$, $\frac{x-2}{3}$, $\frac{x-3}{4}$, $\frac{x-4}{5}$, $\frac{x-5}{6}$, $\frac{x}{7}$, will be the 6 *Conditions* of the Question, expressing the *same whole Number.*

Let *1st* Condition, $\frac{x-1}{2}=a$, Then $x=2a+1$. Substitute which Value of x, in *2d Condition.* Then $\frac{2a-1}{3}$, a *whole* Number,

But, $\frac{3a-3}{3}$, a *whole* Number.

Whence, $x=6b+5$. The *1st and 2d Conditions.* . . . Here, $a=3b+2$ (in *lowest Terms*) Dif. . . , $\frac{a-2}{3}=b$, a *whole* Number.

QUESTIONS *in* CHRONOLOGY *answered.*

Substitute this Value of x, in the 3*d Condition* . . . . Then, $\frac{6b+2}{4}$, or $\frac{3b+1}{2}$, a *whole* Number.

$\left\{ \frac{4b}{2} \right.$, a *whole* Number.

Whence, $x=12c+11$. The 1*st*, 2*d*, *and* 3*d Conditions*. . . . Here $b=2c+1$ . . Dif. $\frac{b-1}{2}=c$, a *whole* Number.

Substitute this Value of x, in the 4*th Condition*. Then $\frac{12c+7}{5}=2c+1, +\frac{2c+2}{5}$, a *whole* Number.

$\left\{ \frac{5c}{5} \right.$, a *whole* Number.

1st Dif. . . . $\frac{3c-2}{5}$, a *whole* Number.

Whence, $x=60d+59$. The 1*st*, 2*d*, 3*d*, *and* 4*th Con*. . In *lowest* Terms, Here, $c=5d+4$. . . 2d Dif. $\frac{c-4}{5}$, $=d$, a *whole* Number.

Also 5*th Condition*, as will appear.

For, substitute this Value of x, in the 5*th Condition*. Then, $\frac{60d+54}{6}$ is a *whole* Number by *Consequence*.

Therefore, substitute the aforesaid Value of x, in 6*th Condition*, Then, $\frac{60d+59}{7}=8d+8, +\frac{4d+3}{7}$, a *whole* Number.

$\left\{ \right.$ But $\frac{7d+7}{7}$, a *whole* Number.

1st Dif. $\frac{3d+4}{7}$, a *whole* Number.

Whence, $420e+119$. The 1. 2. 3. 4. 5. *and* 6*th Conditions*. . . Here, $d=7e+1$ . . . 2d Dif. $\frac{d-1}{7}=e$, a *whole* Number.

The GENERAL AFFIRMATIVE THEOREM, *in the lowest Terms* ; *answering all the Conditions of the Question, let* e *be what it will*.
Let $e=0$, then 119 is the *least* whole Number.
$e=1$, then 539 is the *next* whole Number.
$e=2$, then 959 the *next*, *&c. ad infinitum*.

☞ All other Questions of this Nature are answered in this Manner: the *chief* Business being to reduce the required *Conditions*, to Fractions in the *lowest Terms*, as the Operation proceeds, in order that the *final Theorem* may take in all the *Cases* that can happen; *viz.* from 0, 1, 2, 3, 4, *&c.* the successive Values of the assumed whole Number. And this *Theorem* will be either *affirmative* or *negative*.

OTHERWISE *negatively*.

PUT x for the Number as before, and Conditions the same.

Let $\frac{x-1}{2}=a$, 1*st Condition*. Hence $x=2a+1$, as before. Substitute in 2*d Condition*. Then, $\frac{2a-1}{3}$, a *whole* Number.

$\left\{ \right.$ But $\frac{3a}{3}$, a *whole* Number.

Whence, $x=6b-1$. The 1*st and* 2*d Conditions*. . . . Here, $a=3b-1$ . . . . Dif. . . . $\frac{a+1}{3}=b$, a *whole* Number.

Substitute this Value, in the 3*d Condition*. . . . Then $\frac{6b-4}{4}=\frac{3b-2}{2}$, a *whole* Number.

Whence, $x=12c-1$. The 1. 2. 3. *Conditions*. . . Here $b=2c$ . . . *viz.* $-1+b, +\frac{b}{2}=c$, a *whole* Number.

Substitute this Value of x, in 4*th Condition*. Then, $\frac{12c-5}{5}=-1+2c, +\frac{2c}{5}$, a *whole* Number.

Whence, $x=60d-1$. The 1. 2. 3. 4 *Conditions*. . . . Here $c=5d$ . . . . . . ∴ $\frac{c}{5}=d$, a *whole* Number.

And also 5 *Conditions*, as appears.

For, Substitute this Value of x, in the 5*th Condition*. Then, $\frac{60d-6}{6}$, a *whole* Number by *Consequence*.

Therefore

QUESTIONS *in* CHRONOLOGY *anſwered.*

Therefore, ſubſtitute the ſaid Value of x, in *the 6th Condition.* Then $\frac{60d-1}{7}$, a *whole* Number.

viz. $8d+\frac{4d-1}{7}$, a *whole* Number.

1ſt Dif. $\left\{\frac{7d}{7}\right.$, a *whole* Number.

2d Dif. $\left\{\frac{3d+1}{7}\right.$, a *whole* Number.

Here, $d=7e+2$ . . . . $\frac{d-2}{7}=e$, a *whole* Number.

General affirmative THEOREM.
Whence, $x=420e+119$, as before, anſwering all the Conditions.

But $\frac{7d-7}{7}$, a *whole* Number.

From above. 1ſt Dif. $\frac{3d-6}{7}$, a *whole* Number.

Here, $d=7e-5$. . . . 2d Dif. $\frac{d+5}{7}=e$, a *whole* Number.

General negative THEOREM.
Whence, $x=420e-301$, *anſwering all the Conditions.*

Let $e=1$, then 119 is the *leaſt* whole Number.
$e=2$, then 539 is the next whole Number.
$e=3$, then 959 the next, *&c. ad infinitum,* as before.

QUESTION XIII.

REQUIRED the YEAR *of* CHRIST *when the* Golden Number *is* 5, *and the Cycle of the* Sun 6?
In the 1ſt Condition, 1 is to be added to the Year, to be divided by 19 for the Golden Number 5 to remain.
In the 2d Condition, 9 is to be added to the Year, to be divided by 28 for the Cycle of the Sun 6 to remain.

Conditions 1. 2. 1. 2.

Put $x=$ No. Year ſought: Then $\frac{x+1-5}{9}$, $\frac{x+9-6}{28}$, Or $\frac{x-4}{19}$, $\frac{x+3}{28}$ will be the *two Conditions* of the Queſtion, expreſſing the *ſame whole Number.*

Let 1ſt Condition $\frac{x-4}{19}=a$, Then $x=19a+4$. Subſtituting which in 2d Condition $\frac{19a+7}{28}$, a *whole* Number.

1ſt Dif. $\left\{\text{But } \frac{28a}{28}\right.$, a *whole* Number.

2d Dif. $\frac{9a-7}{28}$, a *whole* Number.

3d Dif. $\frac{10a+14}{28}$, a *whole* Number.

Here, $a=28b-21$ . . . $\frac{a+21}{28}=b$, a *whole* Number.

NEGATIVE THEOREM.
Hence, $x=532b-395$.

AFFIRMATIVE THEOREM.
$x=532b+137$.
Exactly agreeing.

Let b the aſſumed whole No. be what it will.

But $\frac{28a+28}{28}$, a *whole* Number.

From above, 1ſt Dif. $\frac{9a+21}{28}$, a *whole* Number.

2d Dif. $\frac{10a-14}{28}$, a *whole* Number.

Here, $a=28b+7$. 3d Dif. $\frac{a-35}{28}=-1+\frac{a-7}{28}=b$, a *whole* Number.

By the affirmative *Theorem.*
Let $b=0$, Then 137 the leaſt Year of *Chriſt.*
$b=1$, Then 669 the next Year of *Chriſt.*
$b=2$, Then 1201 the next *Year.*
$b=3$, Then 1733 the next *Year.*
$b=4$. Then 2265 the *next, &c.*

QUESTION XIV.

IN what *Year of the* Dionyſian *Period was it in the Year before* Chriſt, *when the Golden Number was* 1, *and Cycle of the Sun* 9?
The FIRST *Conditions* of this Queſtion is to find the leaſt Number, which divided by 19 and 28, ſhall leave 1 and 9 reſpectively remaining.

Conditions 1. 2.

Put $x=$ that Number, Then $\frac{x-1}{19}$, $\frac{x-9}{28}$ will be the 2 *Conditions* of the Queſtion, expreſſing the *ſame whole Number.*

Let

QUESTIONS in CHRONOLOGY *answered.*

Let 1st Condition $\frac{x-1}{19}=a$, Hence $x=19a+1$.

Substitute this Value in 2*d Condition*, Then, $\frac{19a-8}{28}$, a *whole* Number.

But $\frac{28a-28}{28}$, a *whole* Number.

1st Dif. $\frac{9a-20}{28}$, a *whole* Number.

2d Dif. $\frac{10a+12}{28}$, a *whole* Number.

Here, $a=28b-4$ . . . . 3d Dif. $\frac{a+32}{28}=1,+\frac{a+4}{28}=b$, a *whole* Number.

NEGATIVE THEOREM.
Whence, $x=532b-75$.

AFFIRMATIVE THEOREM.
$x=532b+457$.

Let b be assumed so as the No. comes out less than 532.

But $\frac{28a+28}{28}$, a *whole* Number.

From above, 1st Dif. $\frac{9a+36}{28}$, a *whole* Number.

2d Dif. $\frac{10a-44}{28}$, a *whole* Number.

Here, $a=28b+24$ . . . . 3d Dif. $\frac{a-80}{28}=-2+\frac{a-24}{28}=b$, a *whole* Number.

By the Negative *Theorem*.
Let $b=1$, then 457 the Number of the Period.

By the Affirmative *Theorem*.
$b=0$, then 457 is the same Number required.

N. B. The *Dionysian* Period limits the Answer to the *least whole* Number, or Number in *that Period*.

N. B. *Either of the above* Theorems *find as many conditional Numbers as you please.*

QUESTION XV.

THE Golden Number *being one, in the Year before* Christ, *the Cycle of the* Sun 9, (*as before*) *and the* Roman Indiction 3, *what was then the Year of the* Julian Period ?

The *Conditions* here are to find the *least* whole Number, which being divided by 19, 28, and 15; 1, 9, and 3 shall *respectively* remain.

Conditions 1. 2. 3.

Put $x=$ the Number sought, Then $\frac{x-1}{19}$, $\frac{x-9}{28}$, $\frac{x-3}{15}$, will be the 3 *Conditions* of the Question, expressing the *same whole Number.*

Two of which *Conditions* were determined above, *viz.* $x=532b+457$.

Substitute which Value of x, in the 3d Condition, Then $\frac{532b+454}{15}$, a *whole* Number.

Viz. $35b+30+\frac{7b+4}{15}$, a *whole* Number.

$\frac{15b-15}{15}$, a *whole* Number.

1st Dif. $\frac{8b-19}{15}$, a *whole* Number.

Here, $b=15c+8$. . . . 2d Dif. $-1+\frac{b-8}{15}=c$, a *whole* Number.

AFFIRMATIVE THEOREM.
Whence, $x=7980c+4713$.
And when $c=0$, then 4713 is the Number of the *Julian* Period, *required.*

But $\frac{15b+15}{15}$, a *whole* Nnmber.

From above, 1st Dif. $\frac{8b+11}{15}$, a *whole* Number.

Here, $b=15c-7$. . . . 2d Dif. $\frac{b+7}{15}=c$, a *whole* Number.

NEGATIVE THEOREM.
Whence $x=7980c-3267$.
And when $c=1$, then 4713 is the Number of the *Period*, as before.

N. B. *Either of the above* Theorems *find as many conditional Numbers as you please.*

QUESTION XVI.

THE *Golden Number being* 11, *Cycle of the Sun* 2, *and Indiction* 9, *required the* Date *of the Year, O. S. when these happened* ?

QUESTIONS *in* CHRONOLOGY *answered.*

Conditions 1. 2. 3. 1. 2. 3.

Put $x =$ Year fought. Then $\frac{x+1-11}{19}$, $\frac{x+9-2}{28}$, $\frac{x+3-9}{15}$, or $\frac{x-10}{19}$, $\frac{x+7}{28}$, $\frac{x-6}{15}$, will be the 3 *Conditions* of the Queftion, expreffing the *fame whole Number.*

Let 1ft *Condition*, $\frac{x-10}{19} = a$, then $x = 19a + 10$.

Subftitute this Value of x in 2*d Condition.* Then, $\frac{19a+17}{28}$, a *whole* Number.

Whence, $x = 532b + 105$. The 1*ft and* 2*d Conditions.*

But $\frac{28a+28}{28}$, a *whole* Number.

1ft Dif. $\frac{9a+11}{28}$, a *whole* Number.

2d Dif. $\frac{10a+6}{28}$, a *whole* Number.

Here, $a = 28b + 5$. . . . . 3d Dif. $\frac{a-5}{28} = b$, a *whole* Number.

Subftitute, the foregoing Value x, in the 3*d Condition.* Then $\frac{532b+99}{15}$, a *whole* Number.

Viz. $35b + 6 + \frac{7b+9}{15}$, a *whole* Number.

AFFIRMATIVE THEOREM.
Whence, $x = 7980c + 1701$.
And when $c = 0$, then 1701 is the *Date* of the Year, O. S. *required.*

But $\frac{15b+15}{15}$, a *whole* Number.

1ft Dif. $\frac{8b+6}{15}$, a *whole* Number.

Here, $b = 15c + 9$ . . . . 2d Dif. $\frac{b-3}{15} = c$, a *whole* Number.

N. B. *The above Numbers can happen but* once *in a* Julian *Period of* 7980 Julian *Years, as appears by the Theorem: Notwithftanding which, as many* conditional *Numbers of the fame Properties may be found by the Theorem as you pleafe.*

The GENERAL PROPOSITION (Page 161) OTHERWISE Anfwered.

LET *the Quotient of the fame whole Number when divided by another whole Number be called* a, *when divided by a fecond whole Number be called* b, *by a third* c, *by a fourth* d, *by a fifth* e, *by a fixth* f, &c.

FORMER EXAMPLE. To find a whole Number, which being divided by 2, 3, 4, 5 and 6; 1, 2, 3, 4, and 5 fhall, refpectively, remain; but being divided by 7, Nothing fhall remain.

Conditions 1. 2. 3. 4. 5. 6.
Here, $2a+1 = 3b+2, = 4c+3 = 5d+4 = 6e+5 = 7f$, which are the 6 *Conditions* of the Queftion, expreffing the *fame whole Number.*

N. B. *The chief Thing here to be confidered is to find the Value of the different Quotients* a, b, c, d, &c. *of the* fame whole Number, *when divided by different whole Numbers, fo as Nothing fhall remain, according to the feveral Expreffions, and Conditions, as above.*

AXIOM. *Any whole Number taken from the fame, or a different whole Number, a whole Number, or Nothing, fhall remain.*

1. 2. *Conditions.*
In the 1*ft and* 2*d* Conditions. $2a+1 = 3b+2$, a *whole* No. *fought*; a and b conditional *whole* Nos. *required.*
Subtract 1 from each Side, $2a = 3b+1$, a conditional *whole* Number, divifible by 2.
Subtract $2b$ . . a *whole* Number, divifible by 2.

Whence, $3b+2=5$, the 1*ft and* 2*d Conditions.* . . . Here $b=1$, *leaft.* $b+1$, a *whole* Number, divifible by 2.
$a=2$.

NOW, 6 being the *leaft Multiple*, divifible by 2, 3, the *Divifors* refpecting the 2 firft *Conditions*,

3. 1. 2. *Conditions.*
Therefore, . . . $4c+3 = 6a+5$, a *whole* Number *fought*, c and a *whole* Numbers, *required.*
Subtract 3 from each Side . . . $4c = 6a+2$, a *whole* Number, divifible by 4.
Subtract $4a$ . . a *whole* Number, divifible by 4.

$2a+2$, a *whole* Number, divifible by 4.
Whence, $6a+5=11$, The 1. 2. 3. *Conditions.* . . . Here $a=1$, *leaft* . . $a+1$, a *whole* Number, divifible by 2
NOW, 12 being the *leaft Multiple*, divifible by 2, 3, 4, the *Divifors* refpecting the 3 *firft Conditions*,

4. 1. 2. 3. *Conditions.*
Therefore, . . . $5d+4 = 12a+11$, a *whole* Number *fought*, d and a *whole* Numbers, required.
Subtract 4 from each Side . . . $5d = 12a+7$, a *whole* Number, divifible by 5.
Subtract $10a+5$, a *whole* Number, divifible by 5.

Here a may be difcovered $= 4$. . . . $2a+2$, a *whole* Number, divifible by 5.
$5a$ . . . a *whole* Number, divifible by 5.
$3a-2$, a *whole* Number, divifible by 5.
Whence, $12a+11=59$, The 1. 2. 3. 4. *Conditions.* . . Here $a=4$, *leaft* $a-4$, a *whole* Number, divifible by 5.

NOW,

QUESTIONS *in* CHRONOLOGY *answered.*

NOW, 60 being the *least Multiple*, divisible by 2, 3, 4, 5, the *Divisors* respecting the 4 *first Conditions*,
5. 1. 2. 3. 4. *Conditions.*

Therefore, . . . $6e+5 = 60a+59$, a *whole* Number *sought*, *e* and *a* whole Numbers.
Subtract 5 from each Side, $6e = 60a+54$, a *whole* Number, divisible by 6.

Hence, $60a+59=59$, The 1. 2. 3. 4. 5. *Conditions*. . . . Here $a=0$, *least* . . which is *already* divisible by 6.
NOW, 60 being the *least Multiple*, divisible by 2, 3, 4, 5, 6, the *Divisors* respecting the first 5 *Conditions*,
1. 2. 3. 4. 5. *Conditions.*

Therefore, $7f = 60a+59$, a *whole* Number *sought*, divisible by 7, *f* and *a* whole Numbers.
Subtract $56a+56$, a *whole* Number, divisible by 7.

$4a+3$, a *whole* Number, divisible by 7.
$7a$ . . . a *whole* Number, divisible by 7.
$3a-3$, a *whole* Number, divisible by 7.

Whence, $60a+59=119$, The 1. 2. 3. 4. 5. 6. *Con.* Here $a=1$, at least $a+6$, a *whole* Number, divisible by 7.
NOW, 420 being the *least Multiple* divisible by 2, 3, 4, 5, 6, 7, the *Divisors* respecting the 6 *Conditions*,
1. 2. 3. 4. 5. 6. *Conditions.*

Therefore, $420a+119$, will be an AFFIRMATIVE GENERAL THEOREM, by which you may determine as many Numbers as you please, having the aforesaid 6 *Conditions*, where $a=0, 1, 2, 3, 4,$ &c. *assumed at Pleasure.*

☞ *The* LEAST MULTIPLE, *divisible by* several *Numbers*, *is had by a continual Multiplication of the lowest Parts, and least Multiples of these Numbers, that will* compose *all the different* Wholes; viz. *make up as many of the* following *Divisors as you can, out of the* preceding *Ones*, and *their Multiples, for determining the* least *Multiple of all Numbers*, universally.

Example. 2, 3, being different and not divisible by each other have $1\times 2, \times 3=6$ for the *least Multiple.*

But 2, 3, 4, being the same as $2, 3, 2^2$, multiplied together, therefore the different *Numbers* multiplied, taking the square, cube, &c. Roots, *viz.* $2\times 3\times 2=12$, is the *least Multiple* of 2, 3, 4.

Again, 2, 3, 4, 5 being the same as $2, 3, 2^2, 5$, the *different* Numbers multiplied, taking in the Roots, $2\times 3\times 2\times 5=60$, the *least Multiple* of 2, 3, 4, 5.

Again, 2, 3, 4, 5, 6, being the same as $2, 3, 2^2, 5, (2, 3)$ multiplied, the *different Numbers* multiplied, taking in the Roots, and excluding former *Similitudes*, $2\times 3\times 2\times 5=60$, the *least Multiple* of 2, 3, 4, 5, 6.

And, if 2, 3, 4, 5, 6, 7, 8, 9, were the *Divisors*, then $2, 3, 2^2, 5, (2, 3)\ 7, 2^3, 3^2$, will be the *different* Numbers of them multiplied together, taking in their Roots, *viz.* $2\times 3\times 2\times 5\times 7\times 2\times 3=2520$, the least common *Multiple* of them all.
So for other Cases.

QUESTION XVII.

THE *Golden Number being* 12, *Cycle of the* Sun 4, *and* Roman Indiction 7, *to determine the Year of the* Julian *Period, and likewise the Year of* Christ?

Let *a*, *b*, *c*, be the 3 *Quotients* after dividing the Year of the *Period*, by 19, 28, and 15, for 12, 4, and 7, respectively, to remain.
1. 2. 3. *Conditions.*

Therefore, $19a+12 = 28b+4 = 15c+7$.
Subtract 12 . . $19a = 28b-8$, a *whole* Number divisible by 19, *a* and *b whole Numbers.*
Subtract $19b$ . . a *whole* Number divisible by 19.

Remainder $9b-8$, a *whole* Number divisible by 19.
1st Dif. $10b+8$, a *whole* Number divisible by 19.
Here, $b=3$, the *least*. 2d Dif. $b+16$, a *whole* N°. divisible by 19. Whence $28b+4=88$. 1. & 2. *Condit.*

NOW, 532 *being the* least Multiple, *of which* 19 *and* 28 *are Divisors*, respecting the first 2 *Conditions.*
Therefore, $15c+7 = 532a+88$
Subtract 7 . . $15c = 532a+81$, a *whole* Number, divisible by 15, *c* and *a whole* Numbers.
$15\times 35a+5\times 15$. Subtract $525a+75$, a *whole* Number, divisible by 15.

$7a+6$, a *whole* Number, divisible by 15.
$15a+15$, a *whole* Number, divisible by 15.
1st Dif. $8a+9$, a *whole* Number, divisible by 15. [Yr. of Jul. Period, req.
Here $a=12$, the *least*, 2d Dif. $a+3$, a *whole* N°. divisible by 15. . . . Whence $532a+88=6472$
Year of Julian Period 1st Yr. bef. *Chr.* —4713

Year of *Christ*, required . . . 1759

N. B. *The last Quantity divisible by a whole Number should (for finding the least Number sought) be brought out affirmative.*

QUESTION XVIII.

REQUIRED *a* PERSON'S *Age, on* December 4, 1759, *N. S. born* March 8, (since 1700) *in the Year when the* Dominical *Letter O. S. was* B, *and* Golden Number 19? *And required also the* Date *of the* Year, *and Day of the Week, when the same Person was born?*

	Gol. N°. 19.	Dom. Letters.		
By Tab. p. 150.	1709 . . .	B	*By*	Hence, the *Person* was *born* in the *Year* 1709, O. S. since Chr.
All the Dates between	28 with	GE	*Tab.*	Therefore, on *March* 8, O. S. . . . 1759
1700 and 1759.	47 . . .	D	p. 148.	

The Year of the *Person's* Age will be Dif. Years 50

But, *December* 4, 1759, N.S. answers to . . . . . *November* 23, 1759, O. S.
BIRTH-DAY, ... *March* 8, 1759, O. S.
By *Table*, Page 32. The Difference of Days *betwixt which Times*, are $245+15=260$ Days.
For, by *Table*, Page 120, From *January* to *November* 23. . . 327 Days. . . To *March* 8. . . 67 Days. . . Diff. 260
So that the PERSON'S AGE will be 50 Years, and 260 Days, *required.*

ARITHMETICAL OPERATIONS.

TO *turn Time into* Degrees *and* Parts *of the* Equator, *arithmetically?*
RULE. *Take the several Sums of the* Hours, Minutes, *and* Seconds, *and the* Halves *thereof respectively, Then take in or consider a Decimal—Place to the Right Hand of each of which* Sums, *as Units Place, and you will have the* Degrees, Minutes, *and* Seconds *of a Degree answering thereto; which being collected will be the* Degrees *and* Parts *of the Equator, required.*

EXAMPLES.

4 Hours . . . . 5 Hours.
½ . . 2 ½ . . 2.5
Sum 6 Hours = 60°. Sum 7.5 = 75°.

7 Hours 47 Minutes
½ . . 3.5 ½ . . 23.5
Sum 10.5 = 105° 70.5 = 70|5′
11 45′ Divide by 6| . . 11° 45′
Collected Sum 116 45 Degrees and Minutes, *required.*

H M H
Or, 7 47 = 7.78333, *&c.* see p. 14.
½ . . 3.89166
Sum 11.67499
= 116°,75
45′ as before.

13 Hours . . . . . 33 Minutes . . 51 Seconds
½ . . 6.5 ½ . . 16.5 ½ . . 25.5
Sum 19.5 = 195°. Sum 49.5 = 49|5′ Sum 76.5 = 76|5″
8 15′ ÷ 6 . . 8° 15′ ÷ 6 . . 12′ 45″.
12 45″
Collected Sum 203° 27′ 45″ required.

9 Hours . . . . . . 19 Minutes . . . 27 Seconds
½ . . 4.5 ½ . . 9.5 ½ . . 13.5
Sum 13.5 = 135° 28.5 = 28|5′ 40.5 = 40|5″
4 45′ ÷ 6 . . 4 45′ ÷ 6 . . 6′ 45″
6 45″
Collected Sum 139° 51′ 45″, required.

H M S
Or, 13 33 51
,85
= 13.564166, *&c.*
½ . . 6.782083
20.346249 = 203°.46249 . . see p. 14.
as before, 27′.7494
nearly. 44″.964

TO *turn Degrees and Parts of the* EQUATOR *into* TIME, *arithmetically?*
RULE. *Cut off a Figure to the Right Hand, from the* Degrees, Minutes, *and* Seconds, *and take one Third away from each respective Quantity, (after such a Separation of* Integers, *and the Decimal of each to the Right Hand) what remains will be* Hours, Minutes, *and* Seconds *of* TIME, *respectively; which being collected into a Sum will be the* Time *sought.*

EXAMPLES.

Hours.
195° or 19,5°
Subtract ⅓ . . 6,5
Remainder 13 Hrs.

Hours.
8° 15′ = 8°,25 Or ,825
Subtract ⅓ . . ,275
Remainder ,55 Hr.
or 33 Min. reqd.

Mins.
12′ 45″ = 12′,75 Or 1,275
Subtract ⅓ . . ,425
Remainder. Mins. ,85
51 Seconds, reqd.

Secs.
56″ or 5,6
Subtract ⅓ . . 1,8666
Remainder. Secs. 3,7334
44 Thirds, reqd.

Or, ... 13,9° . . . . 5,1′ . . . . . . 4,5″
Subtract ⅓ . . 4,63333 Sub. ⅓ 1,7 Sub. ⅓ . . 1,5
Rem. Hours 9,26667 Rem. M. 3,4 Rem. 3 Secs.
9h 16m 0002 24s
3 24s
+ 3
Collected Sum 9h 19m 27s, required.

20,3° . . . . . 2,7′ . . . . . . 4,5″
⅓ . . 6,76666 Sub. ⅓ . . ,9 Sub. ⅓ . . 1,5
13,53333 Rem. 1,8 = 1m 48s Rem. 3 Secs.
13h 32m
1 48s
3
Collected Sum 13h 33m 51s, required.

Mins.
Or, 27′,45″ = 27′,75, or 2,775
Subtract ⅓ . . ,925
Remainder. Mins. 1,850
51s as before.

A TABLE for finding the NUMBER *of* DAYS advanced and retreated by the EPACTS and LUNATIONS, in the MONTH DAYS, (from 6000 Years before to 6000 Years after *Christ*) from *Old* to *New Style*, from 1800, and the contrary. For determining the EPACT, and Fall of EASTER, according to *New Style*, as settled by Pope *Gregory*. See *Tab.* p. 30. Also to find the Epact, O. S. for the same Centuries.

vide Note P. 177

This Tab for ye B.C are for comp. Yrs

The Left Sty's being B.C

No Cols 1	2.	3.	4.	5.	6.	7.
Centuries before CHRIST, N. S.	Days Diff. from Old to New Style ✕	Days retr. of ☽ Cyc. in O Style	Sum, Days Adv. and retr. of ☽ Cyc. from 1800	☽ A. and Epas Adv. from Old to New Style	Golden Nos.	Epas N. S.
	—		+	+		
B.6000	47	0	24	23	6	29
5900	46	0	24	22	11	23
5800	45	0	24	21	16	17
5700	44	*1	23	21	2	13
B.5600	44	0	23	21	7	8
5500	43	0	23	20	12	2
5400	42	1	22	20	17	27
5300	41	0	22	19	3	22
B.5200	41	0	22	19	8	17
5100	40	1	21	19	13	12
5000	39	0	21	18	18	6
4900	38	0	21	17	4	1
B.4800	38	1	20	18	9	27
4700	37	0	20	17	14	21
4600	36	0	20	16	19	15
4500	35	1	19	16	5	11
B.4400	35	0	19	16	10	6
4300	34	0	19	15	15	*
4200	33	1	18	15	1	26
4100	32	0	18	14	6	20
B.4000	32	0	18	14	11	15
3900	31	1	17	14	16	10
3800	30	0	17	13	2	5
3700	29	0	17	12	7	29
B.3600	29	1	16	13	12	25
3500	28	0	16	12	17	19
3400	27	0	16	11	3	14
3300	26	0	16	10	8	8
B.3200	26	*1	15	11	13	4
3100	25	0	15	10	18	28
3000	24	0	15	9	4	23
2900	23	1	14	9	9	18
B.2800	23	0	14	9	14	13
2700	22	0	14	8	19	7
2600	21	1	13	8	5	3
2500	20	0	13	7	10	27
B.2400	20	0	13	7	15	22
2300	19	1	12	7	1	18
2200	18	0	12	6	6	12
2100	17	0	12	5	11	6

1.	2.	3.	4.	5.	6.	7.
Centuries before and since CHRIST. N.S.	Days Diff. from Old to New Style ✕	Days retr. of ☽ Cycle in Old Style	Sum, Days Adv. and retr. of ☽ Cyc. from 1800	☽ A. and Epas Adv. and retr. fr. O. to N. Style	Golden Nos.	Epas N. S.
	∓		±	±		
B.2000	17 17	1	11	6	16	2
1900	17 16	0	11	5	2	27
1800	16 15	0	11	4	7	21
1700	15 14	1	10	4	12	16
B.1600	14 14	0	10	4	17	11
1500	14 13	0	10	3	3	6
1400	13 12	1	9	3	8	1
1300	12 11	0	9	2	13	25
B.1200	11 11	0	9	2	18	20
1100	11 10	1	8	2	4	16
1000	10 9	0	8	+1	9	10
900	9 8	0	8	−0	14	4
B. 800	8 8	0	8	0	19	29
700	6 7	*1	7	0	5	25
600	7 6	0	7	1	10	*
500	6 5	0	7	2	15	13
B. 400	5 5	1	6	1	1	10
300	5 4	0	6	2	6	4
200	4 ~~3~~	0	6	3	11	28
100	3 ~~2~~	1	5	3	16	23
B. 0	2	0	5	3	1	8
100	1	0	5	4	6	2
200	∓0	1	4	4	11	27
300	1	0	4	5	16	21
B. 400	1	0	4	5	2	17
500	2	1	3	5	7	12
600	3	0	3	6	12	6
700	4	0	3	7	17	*
B. 800	4	1	2	6	3	27
900	5	0	2	7	8	21
1000	6	0	2	8	13	15
1100	7	1	1	8	18	10
B.1200	7	0	1	8	4	6
1300	8	0	1	9	9	*
1400	9	1	0	9	14	25
1500	10	0	+0	10	19	19
B.1600	10	0	−0	10	5	15
1700	11	0	0	11	10	9
1800	12	*1	1	11	15	4
1900	13	0	1	12	1	29

1.	2.	3.	4.	5.	6.	7.
Centuries since CHRIST. N. S.	Days Diff. from Old to New Style	Days retr. of ☽ Cyc. in O. Style	Sum, Days Adv. and retr. of ☽ Cyc. from 1800	☽ A. and Epas retr. from Old to New Style	Golden Nos.	Epas N.S.
	+		—	—		
B.2000	13	0	1	12	6	24
2100	14	1	2	12	11	19
2200	15	0	2	13	16	13
2300	16	0	2	14	2	8
B.2400	16	1	3	13	7	4
2500	17	0	3	14	12	28
2600	18	0	3	15	17	22
2700	19	1	4	15	3	18
B.2800	19	0	4	15	8	13
2900	20	0	4	16	13	7
3000	21	1	5	16	18	2
3100	22	0	5	17	4	27
B.3200	22	0	5	17	9	22
3300	23	1	6	17	14	17
3400	24	0	6	18	19	11
3500	25	0	6	19	5	6
B.3600	25	1	7	18	10	2
3700	26	0	7	19	15	26
3800	27	0	7	20	1	21
3900	28	1	8	20	6	16
B.4000	28	0	8	20	11	11
4100	29	0	8	21	16	5
4200	30	0	8	22	2	*
4300	31	*1	9	22	7	25
B.4400	31	0	9	22	12	20
4500	32	0	9	23	17	14
4600	33	1	10	23	3	10
4700	34	0	10	24	8	4
B.4800	34	0	10	24	13	29
4900	35	1	11	24	18	24
5000	36	0	11	25	4	19
5100	37	0	11	26	9	13
B.5200	37	1	12	25	14	9
5300	38	0	12	26	19	3
5400	39	0	12	27	5	28
5500	40	1	13	27	10	23
B.5600	40	0	13	27	15	18
5700	41	0	13	28	1	13
5800	42	1	14	28	6	8
5900	43	0	14	29	11	2
6000	43	0	14	[illegible]	16	[illegible]

N. B. As 0 signifies the *first* Year current before *Christ*, so 100, 200, 300, &c. signify the 101, 201, 301 Years current before Christ, being all Bissextile. So that 1 must be added to all Years before Christ in the *Table* for the *current* Years. The Tabular Years being the Years *completed*. The Years *after Christ* are set down current *(not completed)* as they *are used* in Chronology.

For the MEMORY.

CONSTRUCTION. RULE I. *Before* Christ, *take the Fourth from the Hundreds less one, Then add two: and the* Difference *of Style will be known.*

RULE II. *From the Hundreds* since Christ, *take their* Fourth, *and* ~~more~~ two, *And the Days will remain betwixt Old Style and New.*

Year
Ex. 55|00 *before* Christ.
−1

¼ 54
13—

v. p. 176

D.
41+2=43, to be subtracted from the Old Style for the New.

Year
36|00 *since* Chr.
2+¼=11—

28 Days to be *added* to the *old Style*, for the New.

N. B. The ☽'s Age and Epacts retr. (—) the same No. of Days that the Lunations adv. (+) from O. to N. S. and the contrary, explaining 5. Col. being the Dif. or Sum of 2d and 4. Columns, according to Signs.

To find the Retreat *of the* Lunar Cycle, *or* Moon's Age, *in the Month-Days of the Old Style, according to its established Rate of* Anticipation *of* 1 *Day in every* 300 *Years, (in round Numbers) or* 8 *Days correctly in every* 2500 *Years (the mean Rate being* 1 *Day in* ~~110~~.7 *Years) from whence the Retreat or Advance of the* Lunations *from Old to New Style, and consequently of the* Gregorian Epacts, *as settled by the* Pope's Authority, *are rightly determined.* 310.7

RULE I. Subtract 17 from the Centuries *since Christ*, and divide the Remainder by 25, multiply the Quotient by 8, and *reserve* the Product.—Divide the last Remainder by 3, and add the Quotient to the *Product reserved*, if there is now no Remainder, it will be the Retreat ☽ Cycle, if there is a Remainder that *Sum* more 1 will be the Cycle's Retreat, *required* from 1800.

Ex. I.
Years
57|00 *since* Christ.
17
25)40(1 by 8 = 8 Product reserved.
25
3)15(5 . . . +5
Remr. 0 Sum 13 Ds Retreat of the ☽ Cycle, to be deducted from the No. of Days advanced from Old to New Style, for the ☽'s Age and Epact retreated that Dif. from those of Old Style, from 1800.

Days
41 Adv. N. S.
—13 Retr. ☽ Cyc.
Diff. 28 Lunations or Epacts retrt. [for that *Period*.

Ex. II.
Years
31|00 since Christ.
17
25)14(0
3)14(4 + 1 = 5 retr. ☽ Cyc. required.
12
2 Remainder, add 1.

31
7
24
2
22 − 5 = 17

To find the Advance of the Lunar Cycle, *or* Moon's Age, *in Old Style, from* 1800, *backward to the Year* 6000 *before* Christ?

RULE. II. Proceed exactly as in the *former* RULE for finding the Retreat of Lunations from 1800 to the Year 6000 *since Christ*; only deduct an *Unit* from the Result of the same *Operation*; taking the Distance of *Centuries* back from the 17th Century in this *backward Computation*, instead of the Distance of *Centuries* forward from the same 17th Century, in the *forward Computation*.

Ex. I.
Years
57|00 before Christ.
+17 Centuries since Christ.
25)74(2, by 8 = 16 *Product reserved.*
50
3)24(8 . . . 8
Sum 24, ~~as the former Operation~~
−1

45 Days ~~23~~ Advance of the Moon's Cycle, to be connected with the ~~44~~ Days *retreated* from Old to New Style, which being *subtracted* therefrom, 21 Days will remain that the ☽'s Age and *Epacts* are *advanced*, or to be *added* to the Old Style's ☽'s Age and Epacts, for those of the New Style, from 1800.

Ex. II.
Years
3|00 since Christ.
17 Centuries since Christ.
25)14(0 by 8 = 0
3)14(4 4
12 1
2, add 1. Sum 5, by 1. *Rule.*
−1

Days 4 Advance of the Moon's Cycle, in the Old Style, to which 1 being added, the Advance from Old Style to New, the Sum will be 5 Days retreated by the ☽'s *Age* or *Epacts* in the Old Style, or to be subtracted from those of the Old for the New.

☞ The Difference between the Advance of the Days from Old to New Style, and the Retreat of the Lunar Cycle being rightly determined, (by the two foregoing Rules) that Difference being the Retreat of the ☽'s Age or Epacts for a *certain Period*, in the Month-Days, O. S. —*To find from thence the Epacts for N. S.?*

RULE. *Multiply the Golden Number for the Year by* 11, *and deduct the said Retreat of* ☽'s *Age or Epacts from the* Product, *(adding* 30, *if it cannot be deducted otherwise) what remains will be the Epact for that Year required.—Or, when (without adding* 30*) the said* Epact *Retreat for Years since Christ is deducted from the said Product of the Golden Number by* 11, *let the Remainder be divided by* 30, *and what remains will be the required Epact.*

Ex. I.
Yrs since Chr. G.N. Ds
2300 . . . . 2 . . . . 14 Epact Retreat
by 11
22
−14
8 Epact, N. S. right

Yr s. Ch. G.N. Ds.
3000 . . 18 . . 16 E.Ret.
11
18
18
198
16
30)182(6
Rem. 2 Epact, N. S. right

30
7
23
2
21
5
16

Yr. s. Ch. G.N. Ds
5700 . . . . 1 . . . . 28 Epact Retreat.
11
11 + 30 = 41
Diff. 13 Epact, N. S. right
as above

41
13
28

45
14
4 3
2
41

Note

CHRONOLOGICAL RULES and REMARKS.

REMARK. *The same numeral Quantities, expressing any Number of Years current since Christ, will not express the same Number of Years* current *before Christ, by the Nature of* Chronology.

The numeral Quantities, 0, 100, 200, 300, *&c.* Years current, *since Christ*, are found to express

1, 101, 201, 301, *&c.* Years current, *before Christ*, and therefore

RULE I. *1 must be added to the numeral* Years 0, 100, 200, 300, &c. *before Christ, in our* Astronomical Tables, *to make them correspond with* 1, 101, 201, 301, &c. *Years* Bissextile, *before Christ, in Chronology: Or, which is the same, you must take out the* Places *from the* Astronomical Tables *aforesaid, for one* Year *less than any Year current before Christ, in Chronology, to correspond with Truth.*

Mr. *Mayer*'s *Astronomical Tables* required the like Correction in their Use, with our Tables, to make all the *solar* and *lunar* Places, for any Number of Years he has expressed, before Christ, to correspond with the *true Years*, current before Christ, according to *Chronology*.

Hence, it is *doubtful*, if Mr. *Mayer* did not first make this necessary Correction, *in taking out his Computations*, whether the *Principles* be correct on which he founds *his Quantities of Acceleration of the Moon's Motion.* For when he examined and compared the lunar Places in his *Tables* with those recorded of antient *Eclipses* and *Observations*, for Years current before *Christ*, they might nearly agree, and yet an Error in Chronology might compensate for another in the *Quantities of Acceleration*; if this should happen to be the Case.

Mr. *Ferguson*, in his Astronomy, has mentioned the foregoing *Paradox* (*without explaining it*) by determining the *28th of May* 585 Years current before Christ (when Peace ensued at the Eclipse, putting an End to the Battle betwixt the *Medes* and *Lydians*) to be on a *Wednesday*, as it happen'd, and not on a *Monday*, according to the *vulgar* Mistake of Chronologers. Who consider the 0 Year for the Beginning of the 1st Year current of Christ (beginning at 0) instead of considering this 0 Year, to be the 1st Year current before 1st Year of Christ, as it *numerically denotes, when* 100 *is put for* 100 *Years current before Christ, that should be signified by* 101, &c.

CHRONOLOGICAL SCALE.

Tabular Years bef. Chr.				Christ.	Tabular Years since Christ.			
400	300	200	100	0	100	200	300	400
401	301	201	101	0	100	200	300	400
Chronological Years before Christ.					Chronological Years since Christ.			

	Tabular Years before Christ.								Christ.	Tabular Years since Christ.								
Tabular less than chronological Yrs. before Christ, by a Year.	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	Tabular and chronological Years since Christ, the same.
	9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
	Chronological Years before Christ.									Chronological Years since Christ.								

From above it is evident that 1 Year less must be used than the *Chronological* Year current, before Christ, to correspond with the *Tabular* Year, in seeking the true Answer from Astronomical or Chronological Tables, or from Arithmetical Operations: Being a Correction in Astronomy and Chronology hitherto unknown, or unobserved.

From above it is evident, that the same chronological with the tabular Year since Christ must be used, in seeking the true Answer from astronomical or chronological Tables, or from arithmetical Operations.

Since therefore the Quantities 0, 100, 200, *&c.*

Numerically denote the 1, 101, 201, *&c.* Years chronologically, or current, before Christ, in our *chronological Tables*, Therefore,

RULE II. *Deduct* 1 *from the chronological Date, or Number of the Year current before Christ; then, with the Year remaining, O. or N. S. find the Dominical Letter, Golden Number, or any other Result, from our Tables, for which they are fitted to determine; and likewise use this remaining Date, in arithmetical Operations concerning Chronology. But never subtract or add any Thing to the Dates, in the Use of our Tables, or any arithmetical Operations about Chronology, for Years current since* Christ.

Of the LEAP-YEAR, *or* YEAR *since.*

TO find, in any Year before Christ, if it was Leap-Year, *or what Year since, according to N. S.*

RULE III. Divide Hundreds *remaining** by 4, or Years over,
What †*remains* take from 4, will the *sought-Year* discover.

* *Even Hundreds after* 1 *subtracted from the Date.*

† 4. 1. 2. 3. Years since Leap-Year.

Examples.

Yrs.
1501 bef. Chr.
— 1
1500 . . 4)15(3
— 3
4
Rem. 1 Year since Leap-Year, N. S.
When 0 remains it is Leap-Year.

Yrs.
14|62 before Christ.
— 1
4)61(15
— 1
4
Rem. 3 Yr. since Leap-Year, N. S.

TO find, in any Year before Christ, if it was Leap-Year, or what Year since, according to O. S.

RULE IV. Dividing by 4, after 1 from the *Date*,
The *Remainder* from 4, shews from Leap-Year *how late.**
*4. 1. 2. 3. Years after Leap-Year.

Examples.

Yrs.
1701 before Christ.
— 1
4)1700(425
10
20
— 0 Leap-Year.
4
Rem. 4 since Lp-Yr. O. S. being Leap-Year.

Yrs.
756 before Christ.
— 1
4)755(188
35
35
— 3
4
Rem. 1 Yr. since Lp-Year, O. S.

TO find, in any Year since Christ, if it be Leap-Year or what Year since, according to N. S.

RULE V. By 4 divide Hundreds, or Years *more*, and then
The *Remainder* will shew if 'tis *Leap-Year*, or *when.**
*0. 1. 2. 3. Years since Leap-Year.

Examples.

Yrs.
16|00 since Christ.
4)16(4
0 Leap-Year, N. S.

Yrs.
17|75 since Christ.
4)75(18
35
3 Yr. since Leap-Year, N. S.

CHRONOLOGICAL RULES.

TO find, in any Year ſince Chriſt, if it be Leap-Year, or what Year ſince, according to O. S.?

RULE VI. If the *Date* of the Year you by 4 ſhould divide,
What *remains* will the *Number** ſince Leap-Year decide.
*0. 1. 2. 3. Years ſince Leap-Year.

Examples.

Yrs. ſince Chr.
4)1751(437
15
31
Rem. 3 Year ſince Leap-Year, O. S.

Yrs. ſince Chr.
4)1800(45
20
Rem. 0 Yr. ſince Lp-Year, O. S.

Of the DOMINICAL LETTER.

TO find the Dominical Letter for any Year before Chriſt, according to N. S.?

RULE VII. Hundreds *Left** quote by 4, and the Letter's *Place* had,
By what's left ſhort of 4, *doubled*; if 1 you add:
Then add once and the fourth of *odd Years*, made 1 leſs,
Quoting Sevens: What *remains* will the Letter expreſs.
* *Even Hundreds after 1 ſubtracted from the Date.*

Example. To find the Dominical Letter for 1535 Years current before Chriſt according to N. S.?

1501
— 1
15|00 . . 4)15(3
— 3
4
1 left ſhort of 4 . . . 1
Doubled 2
Add 1
3 Letter's Place [C, for 1501 before Chriſt, N. S.

35 odd Years.
— 1
¼ . . 34 made 1 leſs.
8
Rem. 42
3 for 1501.
7]45[6
3 . . C, for 1535, N. S.

A B C D E F G.
1. 2. 3. 4. 5. 6. 7.

N. B. *In Leap-Years before Chriſt this Rule gives the 1ſt Dominical Letter of the Two.*

TO find the Dominical Letter for any Year before Chriſt, O. S.?

RULE VIII. The Year Left* its Fourth and 4 divide by 7,
From what *remains* you'll find the Letter given.
* *After 1 ſubtracted.*

Examples.

Yrs.
3740 before Chr.
— 1
¼ . . 3739
934
4
7)4677(668
47
57
1 . . A reqd. O. S.

Yrs.
2325 before Chriſt.
— 1
¼ . 2324
581
4
7)2909(415
10
39
4 . . D reqd. O. S.

N. B. When it is *Leap-Year* this *Rule* finds the 1ſt of the 2 Dominical Letters.

TO find the Dominical Letter for any Year ſince Chriſt, *N. S.?*

RULE IX. Divide *Hundreds* by 4, and to twice what remains,
One added, the Letter for that Year explains;
Take from which (or 7 *added*) what is *Left*, after 7,
Divides the Years *ſince*, and their *Fourth* — And That's *given.**

N. B. When 0 remains for the Letter's Place, after Subtraction, the Letter is G, and ſhews that 7 alſo remains.

*A. B. C. D. E. F. G.
1. 2. 3. 4. 5. 6. 7.

Ex. For 17|59 . 4)17(4
1 Rem.
Doubled 2
Add 1
Sum 3 C the Dom. Let. for 1700. [ſince Chr. N. S.
—3
0 . . or G, Dominical Letter for 1759 ſince Chriſt, N. S.

¼ . . 59 above Hundreds.
14
7)73(1
7
3 Rem. to be ſubtracted.

N. B. When it is *Leap-Year* this *Rule* finds the laſt of the *two* Dominical Letters.

To find the Dominical Letter for any Year ſince Chriſt, O. S.?

RULE X. The Year, its Fourth, and 4, by 7 divided,
What's Left *deduct* from 7, the Letter is *decided.**
*A. B. C. D. E. F. G.
1. 2. 3. 4. 5. 6. 7.

Examples.

Yrs.
¼ . . 1759 ſince Chriſt.
439
4
7)2202(314
10
32
— 4 Rem.
7
Rem. 3 Letter C reqd.

Yrs.
¼ . . 1785 ſince Chriſt.
446
4
7)2235(319
13
65
— 2
7
Rem. 5 Letter E reqd.

N. B. When it is Leap-Year this Rule finds the laſt Dominical Letter of the Two.

Of the WEEK-DAY, FOREVER, O. *or* N. S.

TO find, by the Dominical Letter, O. or N. S. for any Year, or what Day of the Week any Day of the Month happened, or ſhall happen, in that Year?

AT DUBLIN DWELLS GREGORY BLAND ESQUIRE,
GEN'ROUS CHARLES FREEMAN, AND DANIEL FLYER.

USE. In the *Roman Kalendar*, the firſt Day of each Month is denoted as follows;

A. 1.	D. 1.	D. 1.	G. 1.	B. 1.	E. 1.
January.	*February.*	*March.*	*April.*	*May.*	*June.*
G. 1.	C. 1.	F. 1.	A. 1.	D. 1.	F. 1.
July.	*Auguſt.*	*September.*	*October.*	*November.*	*December.*

Correſpondent to the Letter beginning each Word of the foregoing Memorable Couplet.

EXAMPLE. *To find the Week-Day anſwering to* May 24, 1759, *ſince Chriſt, N. S.?*

The Dominical or Sunday-Letter for the Year is G.

Conſequently A denotes *Monday*; B, *Tueſday*; C, *Wedneſday*; D, *Thurſday*; E, *Friday*; F, *Saturday*.

The 1ſt of *May* being always denoted by B, now on a *Tueſday*, therefore *(continually adding 7)* the 8th, 15th, and 22d Days are all *Tueſdays*, and conſequently, the 24th Day is on a *Thurſday*, required. *The ſame Method is to be obſerved for finding the Week-Day to any Month of the Year* (by Memory) *which the* Chronological Tables, p. 149. *exhibit at Sight*; *ſerving* (like the Memorial Rule above) *for any Year before or ſince Chriſt, either according to New or Old Style.*

TO find the Golden Number, or Prime, before Chriſt, O. *or* N. S.

RULE. Deduct 2 from the Date, and divide by 19.
What remains take therefrom and the *Prime* will be ſeen.

CHRONOLOGICAL RULES.

Yrs.
Example. 1611 before Christ.
— 2

(or add 17)

19)1609(84
152
89
76
13—
19

Or, universally, *bef. Chr.*
If the Date and †17, *you by* 19 *divide,*
What remains from 19, *will the* Prime *then decide.* †Comp. of 2 to 19.

G. N°. or *Prime* 6 required.

☞ Compare this *Example* with that p. 150, where 1 should have been deducted from the Year for that Operation.

Being a new Improvement lately made in Chronology, since the former Rule was printed.

N. B. *When the Year before Christ is less than* 2, *deduct it therefrom, and the Remainder is the* Golden Number *for that Year*, by 1 Rule.

TO *find the Cycle of the Sun for any Year before Christ?*
FROM the *Date*, before *Christ*, deducting 10 Years,
28 next divides—Take from that what is *Left*, and the *Cycle* appears.

Yrs.
Example. 397 before *Christ.*
—10
28)387(13
28
107
84
—23
28

Or, universally, *bef. Chr.*
Divide by 4 *Sevens the Date and* †18,
Take what's left from 4 *Sevens, the Sun's Cycle is seen.*

Cycle of ☉ . . 5 required. †Compt. of 10 to 28.

N. B. *When the* Number *of the Year before Christ is less than* 10, *deduct it therefrom, and the Remainder is the Cycle for that Year.*

TO *find the Roman Indiction for Years before Christ?*
From the *Date* deduct 4, then divide by *Fifteen,*
What remains take therefrom, and the Cycle is seen.

Yrs.
789 before Christ
4
15)785(52
75
35
30
—5
15

Or, universally, *bef. Chr.*
Divide by 15, *the Date and* † 11,
Take what's left from 15, *the Indiction is given.*
† Comp. of 4 to 15.

10 Cycle of Indiction, required.

N. B. *When the* Number *of the Year before Christ is less than* 4, *deduct it from* 4, *and the Remainder is the Indiction for that Year.*

☞ As 1, 9, 3, *the* Golden Number, *Cycle of the* Sun, *and* Roman Indiction, *for the Year before Christ's Coming, are added to any Year since Christ, before a Division by* 19, 28, & 15 *respectively, for determining the respective Cycles for that Year*; *so likewise* 2, 10, 4, *the* Golden Number, *Cycle of the* Sun, *and* Roman Indiction, *for the* 1 *Year of Christ, or in the Year since his Coming are to be subtracted from or added to any Year before Christ, the contrary Way on the Scale of* Chronology, *before a Division by* 19, 28, 15, *be made for determining the respective* Cycles *for that Year.* —As herein many Chronologers have been mistaken in their Computations, by subtracting or adding 1, 9, 3 instead of 2, 10, and 4, from or to the Year before Christ, thereby giving their *Results* for a Year 1 less than the True, *on the backward Scale of Chronology.*

TO *find the Year of the* Dionysian, *or any other,* Period, *for any Year before* Christ, *according to the foregoing Improvement?*

☞ GENERAL RULE. *Subtract (if* subtractable) *the Number of any Cycle, in the 1st* Year *of Christ, from the* Date *of the Year before Christ, and divide the Remainder by the* Number *of the* whole *Cycle, what now remains deduct from the* Number *of the said* whole *Cycle, and the last Remainder will be the Year of the Cycle,* required.

N. B. When the Date of the Year before Christ is less than the Number of the Period, in the 1 Year of *Christ*, deduct the Date therefrom, and the Remainder will be the Number of the *Cycle, required,* for that Year.

Yrs.
Example. For 1000 before Christ.
Subtract 458 the N°. of Dion. Per. in 1st Yr. Chr. } it being 457 for the Year before Chr.
Whole Per. 532)542(1
532
—10
532
522 (not 521, See *p* 160.) required.

Or, universally, *instead of subtracting the Period for 1st Yr. Chr. from the Date, add its Comp. to a whole Period.*

☞ *For any Year since Christ there is* no Correction *to former Rules*; our Improvement in Chronology only taking Place for Years ~~since~~ before Christ.

TO find *the* Year *before Christ answerable to any* Year *of any Period,* according to the foregoing Improvement?

☞ GENERAL RULE, the *Reverse of the former General Rule.*
Deduct the Number *of the Period from the whole Period, and add the Remainder to* 458, (the Number in the 1st Year since Christ) *and the* Sum *will be the least* Date *before Christ, when the* Number *of the Period happened as given; to which Date continually adding the* Number *of the whole Period, and you have all the Dates when the* Number *of Cycle or Period so happened.*

Whole Period 532
Ex. The Reverse of the *Former.* The N°. of given Per. 522
Dif. 10
Add 458

The least DATE, *before Christ,* when the N°. of the Period so happened . . . . . . } 468 bef. Chr.
+ 532
Also 1000 bef. Chr.
+ 532
Also 1532, &c.

TO find *the* Number *of the* Julian Period, *according to the foregoing Correction of* Chronology, *for any Year before Christ?*

Yrs.
Ex. For 585 before Christ.
4714 N°. of the Per. in 1st Chr. greater than the Yrs. bef. [Chr. Therefore the Date deducts from it.
Dif. 4129 *Julian Period,* reqd. according to the *General Rule.*

TO find *the* Number *of* Years *before Christ, answering to any* Julian *Period for that* Year?

Ex. Suppose 5320 Julian Period before Christ.
7980 Number of whole Period.
2660
+ 4714

Least *Date,* in the Yr. 7374 before Christ.

The *contrary.* Yrs.
By General Rule. 7374 before Christ.
— 4714
Rem. — 2660 will not div. by wh. Period,
Therefore 7980
5320 N. S. Julian Period, required.

☞ *The Chronological Rules (before these Corrections) take Place by 1st subducting* 1 *from the Date of the Year before Christ, or adding* 1 *to the* Results, to agree with Truth.

CHRONOLOGICAL RULES.

CYCLE *of the* SUN *and* DOMINICAL LETTER TABLE, O. S.

1	GF	5	BA	9	DC	13	FE	17	AG	21	CB	25	ED
2	E	6	G	10	B	14	D	18	F	22	A	26	C
3	D	7	F	11	A	15	C	19	E	23	G	27	B
4	C	8	E	12	G	16	B	20	D	24	F	28	A

To find the Dominical Letter for any Year, O. *or* N. S. *arithmetically?*
Find it correſpondent to the Sun's Cycle, in the annexed Table for O. S. Then reckon the Number of Days between O. and N. S. or the Number of Letters Places forward, that the Difference of Days from O. to N. S. is above 7, 14, 21, *&c.* the Products of 7.

Example. *To find the Dominical Letter for* 1759, N. S.?

Yrs.
1759 ſince Chriſt.
+ 9

28)1768(63 Number of Cycles compleated.

Rem 4, the Number of the preſent Cycle ☉. . . Hence Dom. Letter correſpondent by the above Table is C, for O. S. To which adding the 4th Letter's Place forward (the Difference between 11 and 7) G is the Dominical Letter, *required,* for N. S.

A General Method to find the Epact for O. *and* N. S. *arithmetically?*

☞ The Epact is the Difference of Days between the ſolar Year of 365 and lunar of 364 Days.

	d	h	m	s
For the mean Solar Year =	365	5	48	54
The mean Lunar Year =	364	8	48	36
Dif. Days	10	21	0	18

The Uſe of the Epact is to find the Moon's Age nearly. So that the whole Days are made up in the Reckoning.

To find the Epact for any Year O. S.
RULE. Multiply the Golden Number for the Year by 11, (for the Periods of Hundred Years from 16 to 18,00) divide the Product by 30, the Remainder will be the Epact for that Year, O. S.—Which *Epact* is reduced to *That* for N S. by ſubtracting from it (or 30 added) the Days from O. to N. S.: The Remainder being the Epact anſwerable to the *New.*

Yrs.
Ex. For 1759 ſince *Chr.* O. S. The G. No. is 12
11

only for this
period to 1800

12
12

3|0)13|2(4
Rem. 12 Epact O. S.
Deduct 11 Ds. Dif. fr. O. [to N. S.
Rem. 1 Epact N. S. 1759.

1769 this is not
correct —
as the epact of the cy

To find the Moon's Age, for any Day of the Month in any Year, for which the Epact is given?

You reckon the Number of the Month from *March,* which is called 1, *April* 2, *May* 3, *&c.* to which Number, you add the Day of the Month, and the No. of the Epact, rejecting 30, and the *Moon's Age remains,* within a Day. Or you may uſe the following *Memorial Rule.*

Jan. 0, *Feb.* 2, *Mar.* 1, *Ap.* 2, *May* 3,
Ju. 4, *Jul.* 5, *Au.* 6, *Sep.* 8, *agree;*
Oc. 8, *No.* 10, *De.* 10, — to Epact *add*—
With *Day*—bate 30—*Age* or *Change* is had.

Example. For *July* 25th, 1759.
5 No. Month.
1 Epact.

31
—30

Rem. 1 *Moon's Age.*

N. B. The foregoing New Moon is had by deducting the Moon's Age from the Day of the Month, when it can be done, or otherwiſe adding the Days in the former Month before the Deduction is made. Hence New Moon will be *on* 24*th July,* 1759, nearly.

N. B. *For the Day of the next Full Moon add* 15 *to the Day of the neareſt New Moon.* See PERPETUAL TABLE for finding the *New, Full,* and *Quarter* Moons, p. 152, at Sight—Which Table is ſupplied by the *Perpetual* EPACT TABLE, p. 168. Shewing the Number of Days *Retreat* or *Advance* of the Moons N. S. for given Periods, to be added and ſubtracted to and from the Days the Moons happen in that Table, for *diſtant Periods.* From which EPACT-TABLE, the *Epacts* for *diſtant Periods* are correctly determined.

GENERAL MEMORIAL RULE *for finding the Epact for* N. S.

Divide *Hundreds* by 4, the *Remainder,* thence had,
Multiply by 17, and then 86 *add;*
Forty three, by that *Quote,* muſt be added beſide,
And then 25 the whole Sum muſt divide;
Subtract the laſt *Quote,* from the *Prime* by 11,
Rejecting the *Thirties,* your EPACT is *given.*

Example for 1759.

Hunds.
4)17 (4
——by 43
Rem. 1 ——
Mult. by 17 172
——
17
Add 86
——
103
Add 172
——
25)275(11 laſt Quote
275
——
0

Gol. No. 12
11
——
12
12
——
132
Sub. 11 laſt Quote.
——
30)121(4
120
1 Epact N. S. reqd.

So for the Reſt.

To find the Time of the Moon's Southing and High Water, at London, arithmetically?

The Moon's Age by 4, if by 5 you divide,
Will give you her *Southing:* add 3 for the *Tide.*

Example. The Moon's Age 19 Days
by 4
——
5)76(15h 12m paſt Noon, Time of Southing, required.
26
——
1

Or rather multiply the Moon's Age by 8 *Tenths, which will give you her Southing, in Hours.*

19
,8
——
15,2 = 15h 12m paſt Noon, Time of Southing, required, as before.

To find Eaſter Limit, or the Day of the Paſchal *Full Moon, arithmetically, for* N. S.

If epact is 24 call it 25 and if 25 & 4 above 11 call it 26

If 50 is left subt 1 and if 49 & 4 above 11 subt 1

CHRONOLOGICAL RULES.

30 & more

MEMORIAL RULE.

To the Epact add 6, and reject 2 Times three,
What remains take from 50, your Limit you'll see,
If 50 or 49's Left—when you've done,
And the Prime above 11—Take, for each, less by 1.

Example for 1759. . . Epact 1 . . G. N°. 12.
Add 6

No 30 to reject . . 7—
50

The Limit, . . Days 43 from *March* 1, inclusive.
March 31—

April 12.

To find Easter Day, *or the Number of Days it falls from the first of* March, *inclusive,* arithmetically, N. S.?

MEMORIAL RULE.

Take the Letter and 4, from the Limit Day's Fall,
The Remain from *next Sevens*—Add the *Limit*.—That's all.

Example for 1759. Limit . . Days 43 . . G, Dom. Let. + 7
Sub. 11— Add . . 4

11

Rem. 32—
Next Sevens 35

Rem. . . 3
Add 12 *April*, the Limit.

15 *April*, *Easter*, 1759, [N. S. required.

02
3
43
46
31
15

A TABLE for *readily* finding the YEAR of the *Dionysian* and *Julian* PERIODS, correspondent to given *Cycles* of the *Sun*, *Moon*, and *Indiction*.

N°. ☉. ☽, or Indictn Cycles.	*Solar* Years.	*Lunar* Years.	*Indiction* Years.
1	57	476	6916
2	114	420	5852
3	171	364	4788
4	228	308	3724
5	285	252	2660
6	342	196	1596
7	399	140	532
8	456	84	7448
9	513	28	6384
10	38	504	5320
11	95	448	4256
12	152	392	3192
13	209	336	2128
14	266	280	1064
15	323	224	7980
16	380	168	
17	437	112	
18	494	56	
19	19	532	
20	76		
21	133		
22	190		
23	247		
24	304		
25	361		
26	418		
27	475		
28	532		

Const. For 2d, 3d, 4th, Cols. multiply 57, 476 and 6916 respectively, by the No. of each Cycle in 1st Col. taking the Remainders after Division of the Products by 532, for 2d and 3d Cols. but after Division by 7980 for 4th Column.

N. B. 57 is the Yr. *Dion.* Period, when solar Cycle was 1, and lunar Cycle 19. And 476, Yr. *Dion.* Period, when solar Cycle was 28, and lunar Cycle 1. Also 6916 is Yr. *Julian* Period when 1 was the *Indiction*, and 19 the *lunar* Cycle, *as may be proved.*

Ex. *To find the Year of the* Dionysian *Period answering to* 3 *Gold.* N°. *and* 15 *Cycle* ☉?

Against 3, Golden Number, . . 364 Lunar Years.
15, Cycle of the Sun, . . 323 Solar Years.

Sum 687
Deduct 532 whole Period.

Rem. *Dionysian* Period 155 Yr. required.

Example. *To find the Year of the* Julian Period, *answering to* 17, *Cycle of the Sun*; 12, *Cycle of the Moon*; *and* 13, *Cycle of* Indiction?

Against 17, Cycle of the Sun . . 437 Solar Years.
12, Cycle of the Moon, . . 392 Lunar Years.

Sum 829
Deduct 532 whole Period.

Rem. *Dionysian* Period 297 ÷ 15.
Rem. 12—
Indiction 13
Rem. 1 . . Tab. N°. 6916 4th Column.

Julian Period 7213 required.

Or, from above, 829 ÷ 15.
Rem. 4—
Indiction 13
Rem. 9 . . Tab. N°. 6384

Julian Period 7213 as before.

So for the Rest.

FROM *the* 3 CYCLES *of the* SUN, MOON, *and* INDICTION, *given, to find the Year of the* Dionysian *and* Julian *Period arithmetically?*

See Rules, Page 160.

ANOTHER GENERAL RULE.

Subtract the Lunar from the Solar Cycle, (or from 28 added, if not otherwise subtractable) and multiply the Remainder by 56: To this *Product* add the solar Cycle, dividing the last Sum by 532 (if greater than that Number) and the Remainder will be the *Dionysian* Period answering to the Solar and Lunar Cycles.

From this Period found, subtract the Number of the Indiction (or from 532 added if not otherwise subtractable) dividing the Remainder by 15; then multiply what remains by 1064, deducting (if possible) 7980 from that Product, add the Year of the said *Dionysian* Period to the Remainder, and the last Sum will be the Number of the *Julian* Period, *required.*

Example. *To find the Year of the* Julian *Period answering to* 17, *Cycle of the Sun*; 12, *Cycle of the Moon*; *and* 13, *Cycle of Indiction.*

17 Solar Cycle.
—12 Lunar Cycle.

Rem. 5, × 56 = 280
Solar Cycle + 17

Dionysian Period 297
Indiction —13

÷ 15 . . 284
Rem. 14
× 1064 14896
Dionysian Period from above +297

Sum, 15193
Subtracting 7980

Rem. the *Julian* Period 7213

USE *of the* TABLE *to the* LEFT.

Take out the Number of Solar and Lunar Years from the 2d and 3d Columns answering to the Number of the Solar and Lunar Cycles: and add together for the *Dionysian* Period, if less than 532; but if greater, take 532 therefrom, and the *Dionysian* Period will remain. — Now divide this Period by 15, and take the Remainder from the Indiction Cycle, (or from 15 added thereto) and with the last Remainder in the 1st Column, take out the Number in the 4th Column correspondent: the Sum of which, and the *Dionysian* Period, will be the *Julian* Period.

Or divide the Sum of the Numbers in 2d and 3d Columns by 15, and the Remainder taken from the Indiction will give a Number in the 4th Column, (answerable to that Remainder in the 1st Column) which being added to the Sum of the Numbers in the 2d and 3d Cols. will be the *Julian* Period, required.

CHRONOLOGICAL RULES.

The ANTIENT *Paschal* TABLE for finding EASTER, O. S.

Golden No.	Dom. Letter.	Month Day.
16		
5	D	22
•	E	23
13	F	24
2	G	25
•	A	26
10	B	27
•	C	28
18	D	29
7	E	30
•	F	31
15	G	Apr. 1
4	A	2
•	B	3
12	C	4
1	D	5
•	E	6
9	F	7
•	G	8
17	A	9
6	B	10
•	C	11
14	D	12
5	E	13
•	F	14
11	G	15
•	A	16
19	B	17
8	C	18
	D	19
	E	20
	F	21
	G	22
	A	23
	B	24
	C	25

Ex. *To find when* Easter *happened* 1593, *when the* G. No. *was* 17, *and* Dominical Letter G?

Against 17, G. No. in the 1st Column, stands A, and against G, the Dominical Let. following, stands *April* 15, for the Time of Easter, required.

N. B. The Day of the Month against the Golden Number, *April* 9, is the Day of Easter Full Moon, preceding *Easter-Sunday*. If the Dominical Letter stands against the Golden Number, or the Easter Moon be on a *Sunday*, then Easter is on the *Sunday* following, for the Dominical Letter must follow the Golden Number.

So for the Rest.

To find the Letter in the Roman *Calendar, correspondent to any Month-Day in the Year, before or since* Christ, arithmetically?

RULE. Divide the Number of Days, counting from the Beginning of the Year, or *January* 0, to the given Month-day (*see Tab. p.* 129.) by 7, and what *remains will be the Number of the Letter, *required.*

Example. Required the Letter answerable to the 15th of *November*, in any common or Bissextile Years?

Com. Yr.
7)319(45
39
* Rem. 4 . . Letter D, required, for a common Year.

Bis. Yr.
7)320(45
40
* Rem. 5 . . Letter E, required, for a Bissextile Year.

A	B	C	D	E	F	G.
*1.	2.	3.	4.	5.	6.	7.

RULES FOR FINDING THE WEEK-DAYS.

To find the Week-Day, arithmetically, *answerable to a given* Month-day, *in any Year before Christ*, O. S.?

RULE. To the Years, less 1, before Christ, add their Fourth, (being the Number of their Bissextiles) and 3, and also the Complement of the Number of the Month-day, from *Jan.* 0. (*from Tab. p.* 129.) to next Sevens, or (universally) to 371, divide the last Sum by 7, and deduct the Remainder from 7, and what last *remains will be the Week-day, required. . . Sun. Mon. Tu. Wed. Th. Fr. Sat.
1. 2. 3. 4. 5. 6. 7. *Feriæ.*

Example. *To find the Week-day answering to* May 28, 585 *Years before Christ*, O. S.

Yrs.
585
—1
584 }
¼ . . 146 } add
3 }
222 }
7)*955(136
25
45
—3
7
4 . . Wednesday, O. S. required. *right*

Ds.
From *Jan.* 0, to *May* 28, Biss. 149—
371
Comp. 222
Or
7)149(2
Rem. 2 Week-days, 28th *May* is forward of *Jan.* 0.

Otherwise
584
146
3
7)733(14
Rem. 5—
7
2 *Monday*, *Jan.* 0, or the 31st of *December*, preceding *Jan.* 1.
+2 Week-days 28th of *May* is forward.
4 . . *Wednesday*, as before.

N. B. *The Dominical Letter, before Christ, advances,* (in Reckoning back, *at the Dom. Let. Tab. shews, p.* 148, *for Years before Christ) and consequently the Week-day, on* Jan. 0, *each Year goes back or retreats.* Hence the Reason of adding the Comp. of the Month-days to Sevens from *January*.

To find the Week-day *for any Month-day and Year before Christ*, N. S. arithmetically?

RULE. To the Years, less 1, before *Christ*, add their Fourth and 3, (but 2 from *Feb.* 25 to the End of Centuries, not Lp. Yrs. N. S.) and also the Complement of the No. of the Month-day since *Jan.* 0, (*fr. Tab. p.* 129.) to next Sevens, or (*universally*) to 371, and likewise the Complement of the Day's Difference between O. and N. S. to next Sevens, then divide the Sum by 7, taking the Remainder from 7, and the last Remainder will shew the Week-day, N. S. required.

Let the Week-day for the 28th of May, N. S. *be required?*

585
—1
584 }
¼ . . 146 }
3 } add
222 }
1 }
7)956(1
Rem. 4—
7
3 . . *Tuesday*, N. S. required. *right*

Ds.
From *Jan.* 0, to *May* 28, Biss. 149
371
Comp. 222

Ds. 6 Dif. bet. O. and N. S.
Next 7
1 Comp.

Otherwise.
4 *Wednesday*, O. S.
+6 Dif. Ds. fr. O. to N. S.
7)10(1
Rem. 3 . . *Tuesday*, N. S. as before. (*Adding the Days Difference of Styles to the Week-Day of* O. S. *dividing by* 7, *taking the Remainder for the Week-Day*, N. S.)

N. B.

CHRONOLOGICAL RULES.

N. B. The Week-day for corresponding Month-days of O. and N. S. being the same, when the Dif. of Month-days subtracts from O. for N. S. (before *Christ*) the Difference of Week-days from O. to N. S. adds or advances, as much; or, when (since *Christ*) the Difference of Month-days adds to O. for N. S. the Difference of Week-days subtracts or retreats as much; *respecting the same Month-Day in both Styles.*

To find the Week-Day arithmetically, *answerable to a given Month-Day, in any Year since* Christ, *O. S.?*

RULE. To the complete Years *since Christ* (*viz.* 1 less than the Years current) add their Fourth, —1, and also the Number of the Days since the Beginning of the Year, or *Jan.* o. (from *Tab. p.* 129.) divide the Remainder by 7, and what last † remains, will be the Number of the Week-Day, *required,* O. S.

	Sund.	Mon.	Tu.	Wed.	Th.	Fr.	Sat.
†	1.	2.	3.	4.	5.	6.	7.

Example. To find the Week-Day answering to May 15, 1759, current since Christ, O. S.

1759,
—1
1758
¼, —1 . . 438
Days 135 fr. Jan. o, to May 15, com. Year.
7)2331(333
23
21

† Rem. o, or 7. Saturd. O. S. required.

To find the Week-Day, arithmetically, *answerable to a given Month-Day, in any Year since Christ,* ~~O. S.~~ *? N S*

RULE. To the complete Years since *Christ* (*viz.* 1 less than the Years current) *add* their *Fourth,* —1, and the Number of the Days since the Beginning of the Year, or *Jan.* o. (*from Tab. p.* 129.) and from the Sum of these *subtract* the Number of Days Difference between O. and N. Style, then divide the Remainder by 7, and the last Remainder will be the Number of the Week-Day, required, N. S.

Example. To find the Week-day answering to *May* 15, 1759, current since Christ, N. S.

1759,
—1
1758
¼, —1 . . 438
Days 135 from *Jan.* o, to *May* 15 com. Yr.
2331 Sum as before.
—11 Dif. bet. O. and N. S.

Otherwise. 7)2320(331
o *Saturday*, O. S. 22
—11 (adding Sevens to o.) 10

Rem. 3 *Tuesday*, N. S. [as before. *Rem. 3 . . *Tuesday*, N. S. required.

N. B. *The Dominical Letter, since Christ, retreats,* (in reckoning forward, as the *Dom, Letter Table shews, p.* 148. for Years since *Christ*) *and consequently the Week-day, on* Jan. o. *each* Year, *goes forward or advances.* Hence the Reason of adding the Month-days from *January,* and not their Complement to Sevens, as before *Christ.*

UNIVERSAL and CORRECT RULES for finding the DOMINICAL LETTERS before *CHRIST*, according to N. and O. STYLE; deduced from the Principles of the DOMINICAL LETTER TABLES, Pages 148 and 149: *being a further Illustration of* Rules VII. & VIII. p. 171.

To find the Dominical Letter for any Year *before Christ,* O. S. arithmetically?

RULE. To Years current *less* 1, add their *Fourth,* and twice 2,
Quote by 7, and what's †*Left* will the Letter's Place shew.

	A.	B.	C.	D.	E.	F.	G.	
†	1.	2.	3.	4.	5.	6.	7.	O. S. *before Christ.*

N. B. *Before Christ when it is* Leap-Year *the first Letter is shewn of the Two; and the Second Letter succeeds the Number of the Former.*

Example. 1759 before *Christ.*
—1
1758
¼ . . 439
4
7)2201(314
10
31

Add Sevens . . 3 . . Dom. Let C, for O. S. reqd.
Subtract 15 . . No. Days Dif. from O. S. to N.

Rem. 2 Dom. Let. B. N. S.

To find the Dominical Letter for any Year *before Christ,* N. S. arithmetically?

RULE. Divide Hundreds by 4, take what's left from twice 2,
One with twice what remains will that Year's Letter shew;
Add once and the Fourth, of the *plus* Years less one,
Quote by 7, and the Letter by what's left is known.

Hund. *N. S. before Christ.*

Example for 1759. 4)17(4
Rem. 1—
4
3, twice which +1=7, Letr. G for 1700.
58 plus years —1.
¼ 14
7)79(11
2 rem. B. Dom. Let. [N. S. required.

N. B. *Bef. Christ, when it is Leap Year the first Letter is shewn of the two; and the 2d Letter follows the Number of the former.*

Twice what rem. +1 making 9, for Leap-year Cents, 7 deducts, and the Dom. Let. is B, answering to 2.

☞ *When the Dominical Letter retreats (reckoning for* Years *forward from* 200 *since Christ) the Difference of Days between* O. *and* N. Style, *advances, or adds to the Month-days of* Old, *for the Month-days of* New Style. *And also adds to the Number of the Dominical Letter of the* Old, *for the Number of the Dominical Letter for the* New Style. *And when the Dominical Letter advances (reckoning for* Years *backward before Christ) the Difference of Days between* Old *and* New Style, *retreats, or subtracts from the Month-days of* Old, *for the Month-days of* New Style, (from 200 Years since *Christ.*) *And also subtracts from the Number of the Dominical Letter of the* Old, *for the Number of the Dominical Letter for the* New Style, *from* 200 Years *since Christ, when* both Styles were exactly alike; as may be seen by *Tab. p.* 168.

UNIVERSAL PRACTICAL RULE for finding the DAY'S DIFFERENCE from OLD to NEW STYLE, before CHRIST *for Years above Hundreds.*

Before *Christ,* take the *Fourth* from the Hundreds —that done—
Then add two: and the *Difference* of Style will be known.

N. B. *The above* Rule *agrees with the Difference in the Dominical Letter Tables for Old and New Style before* Christ, *and with Table, p.* 168. Or, if you add 1 to the Centuries, in Dates above Centuries before *Christ,* the FIRST RULE (at Bottom of the Table, p. 168.) will serve, *universally,* for finding the Difference of Style for Dates above complete Centuries—It then amounting to no more than the *Universal Rule* last given: The said first Rule serving only for complete Centuries, that are not Leap Years, from the 25th of *February* to the End of those Centuries.

The Difference of Days (for the greatest Part of a Century) increased by 1, *from* Old *to* New Style, *does not take Place till the* 25th *of* February, *after the Bissextile-Hundred is begun.*

CHRONOLOGICAL RULES.

☞ In *Table*, p. 168, the Day's Difference of Style between O. S. Leap-year, and those Centuries, not Leap-years, N. S. before *Christ*, take Place only for those compleat Centuries, and only from *February* 25, to the End of those Centuries, not Leap-years, N. S. respectively; and the Rest of the Numbers likewise take Place in the same Manner, for the same compleat Centuries. And therefore, any Dates above compleat Centuries before *Christ* will have the same Days Difference in the 2d Column between Old and New Style, and likewise the same Numbers in the 4th and 5th Columns, as at the preceding compleat Centuries, and so in Succession.

That, to find the Difference of Days between Old and New Style, Retreat of Lunations in Old Style, and Advance and Retreat of Lunations and Moon's Age, from Old to New Style, [*in Col.* 2, 4, & 5, *from Tab. p.* 168.] for Years above compleat Centuries before *Christ*.

You must take out the Numbers for 100 Years preceding, as you do for Years above compleat Centuries since *Christ*, *which will then exactly agree with the foregoing* Practical Rule, *for finding the Difference of Styles for Years above compleat Hundreds before Christ.*

TO *reduce* Years before, *to* Years since, *CHRIST, and the contrary; Having the* same Dominical Letter, *or* Letters, *and consequently, beginning with the* same Day of the Week, Old and New Style.

Years before *Christ* reduced to Years since *Christ*, O. S.
RULE. Before *Christ*, take the Number of Years less by One,
From Hundreds by 7, and the Year since is known.

Example. 585 Years current before *Christ*. or 584
—1 700
116
584—
1400 . . 2 Hundreds by 7. right

816

Rem. 816 Years *current since Christ*, having the same Dominical Letters, [*viz.* FE for O. S.] and beginning with the same Week-day, [*viz. Tuesday*] as 585 *Years current before Christ*, O. S.

Years since *Christ* reduced to Years before *Christ*, O. S.
RULE. Years current since *Christ* take from Hundreds by Seven,
Add 1 to what's Left; Years before *Christ* are given.

Example. 1759 Years current since *Christ*. or 1759
2800 . . 4 Hundreds by 7. 2100
1041 341
+1 1
342

1042 . . Years current before *Christ*, having the same Dominical Letter [*viz.* C, O. S.] and beginning with the same Week-day, [*viz. Friday*] as 1759 *Years since Christ*, O. S. right

N. B. The Rules above serve for N. S. by using Hundreds by 4, instead of Hundreds by 7. *Viz.* for N. S.
Before *Christ* take the Number of Years less by 1,
From Hundreds by 4, the Year since *Christ* is done.

Example. 585 Yrs. current bef. *Chr.*
—1
—584
1600 . . 4 Hundreds by 4.

Yrs.
585 before *Christ*, Dom. Letters GF, Year begins on *Monday*, N. S.

1016 Years since *Christ*, Dom. Letters GF, Year begins on *Monday*, N. S.

or 584
800
216

Since *Christ* the Years current from 4 Hundreds take,
Adding 1 to what's Left, Years before *Christ* will make.

1759 Years current since *Christ*.
3200 . . 8 Hundreds by 4.
1441
+1
1442 . . Yrs current bef. *Christ*, Dominical Letter G, Year begins on a *Monday*, N. S.

Yrs.
1759 since *Christ*, Dominical Letter G, Year begins on a *Monday*, N. S.

1759
2000
241
1
242

☞ *In the same Manner, the Years since Christ, are found correspondent to the Years before Christ, having the same Golden Number, Cycle of the Sun, or Indiction; by subducting* 1 *from current Years before Christ, and taking the Remainder from any Number of Hundreds by* 19, 28, *and* 15, *and the Years since Christ will, respectively, remain.* *And*, on the contrary, *taking the current Years since Christ, from any Number of Hundreds by* 19, 28, *and* 15, *adding* 1, *to each Remainder, and the Years current before Christ will result, having the same Golden Number, Cycle of the Sun, and Indiction, respectively.*

Yrs.
Example I. Of the Golden Number 1612 before *Christ*.
—1
—1611
1900 . . 1 Hundred by 19.
Years current since *Christ* 289

1612
1601
289

And 1612 before, and 289 Years since *Christ*, have the same Golden Number, *viz.* 5.

Example. II. Of the Golden Number 2189 since *Christ*.
3800 . 2 Hundreds by 19.
1611
+1

Yrs.
2189 since *Christ*, 1612 before *Christ*.
Golden Number 5. . . . By *Tab.* p. 150. . . Golden Number 5.

The Examples *for the Solar Cycle and Indiction are similar to the foregoing.*

As the antient *Egyptian*, *Arabic*, *Grecian*, *Persian*, *Jewish*, and later Accounts of Time, are reduced, (for astronomical and chronological Purposes) to correspond with the *Julian* Form of the Year, or Account of Time, long before any such Year had Existence, so, in Conformity to the late Correction of the *Julian* Account of Time, we have reduced the *Julian* to the *Gregorian* Style, as far backward and forward as remotest Antiquity, and Futurity, for the Improvement of Chronology and Astronomy. This is performed at Sight, in two Pages, 148 and 149, foregoing, with the following *Rules* to those Pages.

☞ *For the* Commencement *of the most famous* Æras (*since Creation*) *and the* Reduction *of* Chronology, *see further on.*

A Table *of* Kalends, Ides, *and* Nones, *for the* Roman Year. *Of* Use *in* HISTORY *and* CHRONOLOGY.

Days	January.	February.	March.	April.	May	June.	July.	August.	Sept.	Octo.	November	December
1	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.	Kal.
2	4 No.	4 No.	6 No.	4	6 N.	4 N.	6 N.	4 N.	4 N.	6 N.	4 N.	4 N.
3	3 No.	3 No.	5 No.	3 No.	5	3	5	3 N.	5 N.	5	3 N.	3 N.
4	Pr. No.	Pr. No.	4 No.	Prid.	4	Prid.	4	Prid.	Prid.	4	Prid.	Prid.
5	Nones.	Nones.	3 No.	Non.	3 N.	Non.	3 N.	Non.	Non.	3 N.	Non.	Non.
6	8 Id.	8 Id.	Prid.	8 Id.	Prid.	8 Id.	Prid.	8 Id.	8 Id.	Prid.	8 Id.	8 Id.
7	7 January.	7 February.	Non.	7	Non.	7 June.	Non.	7 August.	7	Non.	7	7 December.
8	6	6	8 Id.	6 April.	8 Id.	6	8	6	6 Sept.	8	6 Nov.	6
9	5	5	7 March.	5	7 May.	5	7 July.	5	5	7 October.	5	5
10	4	4	6	4	6	4	6	4	4	6	4	4
11	3 Id.	3 Id.	5	3	5	3 Id.	5	3 Id.	3 Id.	5	3 Id.	3 Id.
12	Pr. Id.	Pr. Id.	4	Prid.	4	Prid.	4	Prid.	Prid.	4	Prid.	Prid.
13	Idus.	Idus.	3 Id.	Ides.	3 Id.	Idus.	3 Id.	Idus.	Idus.	3 Id.	Idus.	Idus.
14	19 K.	16 K.	Prid.	18 K.	Prid.	18 K.	Prid.	19 K.	18 K.	Prid.	18 K.	19
15	18	15	Idus.	17	Idus.	17	Idus.	18	17	Idus.	17	18
16	17	14	17 K.	16	17 K.	16	17 K.	17	16	17	16	17
17	16	13	16	15	16	15	16	16	15	16	15	16
18	15 February.	12 March.	15 April.	14	15	14 July.	15	15	14	15	14 December.	15
19	14	11	14	13 May.	14	13	14	14 September.	13 October.	14	13	14
20	13	10	13	12	13 June.	12	13 August.	13	12	13	12	13
21	12	9	12	11	12	11	12	12	11	12 November.	11	12 January.
22	11	8	11	10	11	10	11	11	10	11	10	11
23	10	7	10	9	10	9	10	10	9	10	9	10
24	9	6	9	8	9	8	9	9	8	9	8	9
25	8	5	8	7	8	7	8	8	7	8	7	8
26	7	4	7	6	7	6	7	7	6	7	6	7
27	6	3 K.	6	5	6	5	6	6	5	6	5	6
28	5	Prid.	5	4	5	4	5	5	4	5	4	5
29	4	———	4	3 K.	4	3 K.	4	4	3 K.	4	3 K.	4
30	3 K.	———	3 K.	Prid.	3K.	Prid.	3 K.	3 K.	Prid.	3 K.	Prid.	3 K.
31	Prid.	———	Prid.		Prid.		Prid.	Prid.		Prid.		Prid.

An Account *of the* Old *and* New Ecclesiastical *and* Civil Calendar. *Of* Use *in* History *and* Chronology.

CALENDAR, or Account of the Year, borrows it's Name from *Kalend*, signifying the first Day of each Month, reckoning according to the *Roman* Account by the Moon. *Kalend* is derived from καλέω, *voco*, I call: For the *Priest*, whose Business it was to observe the *New Moon*, by which the first Day of each Month was reckoned, gave Notice thereof to the *President* of the Sacrifices, who called the People together, and ordained how the rest of the Days, in that Month, were to be set apart for religious and other Uses. Hence it was, that an Annual Account of divine and human Affairs, came to be kept throughout all the Months of the Year; which Account (from reckoning by the *Kalends*) was therefore called *The Calendar-Table*, and considered both as *Ecclesiastical* and *Civil*.

The Day preceding the *Kalends*, or first Day of each Month, was called *pridie Kalendas*, the preceding Day to this the 3d of the *Kalends*, the next preceding Day the 4th of the *Kalends*, &c. reckoning backwards to the *Ides* of the preceding Month.

The Day immediately following the *Kalends* of each Month was called the 4th or 6th of the *Nones*; always reckoning backwards in each Month from the first Day of Nones. In the Full Months of *March*, *May*, *July* and *October*, wherein are six of the *Nones*, the first of the *Nones* fell upon the 7th Day; but in all the Months called *Hollow* or *Cave*, wherein there are reckoned but four of the Nones; the first of those *Nones* fell upon the 5th Day. And there being eight of the *Ides* in each Month, throughout the Year, consequently the 15th Day, in the *Full* Months, and 13th in the *Hollow*, will be the Days of the *Ides*, from whence the rest are reckoned, like the *Kalends*, by inverted Order. The Day preceding the *Nones*, or *Ides*, is called *pridie Nonas*, or *pridie Idus*, the next preceding Days to these, the 2d, 3d, 4th, &c. of the *Nones*, or of the *Ides*, according to the following Observation of the Schools.

Prima Dies Mensis cujusque est dicta Kalendæ,
Sex Nonas, Maius, Octob r, Julius, et Mars;
Quatuor at Reliqui: dabit Idus quilibet octo,
Inde Dies reliquos omnes dic esse Kalendas,
Quas retro numerans, dices à Mense sequenti.

This was the ancient Way of reckoning Time in the *Latin* Churches, and is used in the *Prayer-Books* of the Church of *England* at this Day.

The *Ecclesiastical* and *Civil Calendar*, or Almanack, also disposes of all the Days of the Year into *Months*, *Week-Days*, *Vigils*, *Fast-Days*, *Holy Days*, *Law-Days*, *University Terms*, &c. in a successive Order of reckoning; which being *interrupted* cannot constitute, literally, a *Calendar*.

The *Week-Days* are distinguished by seven Letters, *a*, *b*, *c*, *d*, *e*, *f*, *g*. The first Letter *a* is placed against the 1st of *January*, *b* against the 2d, *c* against the 3d, *d* against the 4th, and so on to *g* against the 7th, then *a* against 8th, *b* against 9th, and so on, in Succession of the seven Letters, through the Year: By which Means *a*, *b*, *c*, *d*, *e*, *f*, *g*, will always point out the same *Week Days* in any Year. And *a*, *d*, *d*, *g*, *b*, *e*, *g*, *c*, *f*, *a*, *d*, *f*, the 1st Day of each of the 12 Months, respectively.

The *principal* Letter of the seven, pointing out the *Sundays* for any Year, is always made *Capital*, and called the *Dominical Letter* for that Year.

Dividing 365 Days, in a common Year, by 7, the Quotient is 52 Weeks, and one Day over; if there had been no Remainder, all Years would begin and end on the same Day of the Week: But the odd Day occasions each Year to end on the Week-Day with which it began, whereby the next Year begins on the Week-Day following. And a Year of 366 Days divided by 7, having two Days remaining, the next Year begins two Week Days after the Week-Day on which the former Leap-Year began: Whence, if a common Year begins on a *Sunday*, pointed out by the *Dominical Letter* A, it will also end on a *Sunday*, and the next, or second Year, will begin on a *Monday*, against which stands *a*; against *Tuesday b*; against *Wednesday c*; and so on to *Sunday*, against which stands G, the Dominical Letter for that Year. Against the Beginning of the third common Year, on a *Tuesday*, stands *a*, against *Wednesday b*, &c, to F, the Dominical Letter against *Sunday* for that Year.

And

And therefore E is the Dominical Letter for the fourth Year, beginning on a *Wednesday*, and so on, in a retrograde Order of Dominical Letters for each succeeding Year. But in this fourth Year, containing 366 Days, called *Bissextile*, or Leap-Year, the 24th Day of *February*, answering to the 6th of the Kalends of *March*, is twice reckoned, by placing the Letter *f* against the 24th and 25th of *February*, which interrupts the annual Retrogression of Dominical Letters, from E, the *Sunday*-Letter to 24th of *February*, to D, the *Sunday*-Letter following the 24th of *February*, to the Year's End. And the fifth Year (of 365 Days) begins two Week-Days after the Week-Day beginning the Leap-Year, *viz.* on a *Friday*, when the Dominical Letter is C; and so for the sixth Year it is B, the seventh A, and the eighth G, and F, and so on. Whereby it is observable, that, after seven Years, if each Year consisted but of 365 Days, the Days of the Month would again return on the same Days of the Week: But by the Interruption, every four Years, to each Letter, it is 7 Times 4, or 28 Years, before the Days of the Months return exactly on the same Days of the Week; which Term of Years is called the *Cycle* of the Sun. But, in *New Style*, this *Order* is now farther *interrupted*, by a Day *less* reckoned, in every odd *Hundredth* Year, being now made *common*, instead of *Bissextile*, as in *Old Style*.

The Cycle of the Sun-Table, for any Year of the Cycle, of Use in History and Chronology, O. S.

1	GF	5	BA	9	DC	13	FE	17	AG	21	CB	25	ED
2	E	6	G	10	B	14	D	18	F	22	A	26	C
3	D	7	F	11	A	15	C	19	E	23	G	27	B
4	C	8	E	12	G	16	B	20	D	24	F	28	A

This Table and the following Rule, are here repeated for Use.

N. B. *In the first Year of Christ, the Year of the Cycle being* 10, *therefore adding* 9 *to the Year since Christ, and dividing the Sum by* 28, *the Remainder will be the Year of the present Cycle as above, to which the Dominical Letters are determined.* See Pages foregoing *for finding the Dominical Letters O. S. arithmetically.*

The *Fixed Feasts* in *O. S.* were regulated by the Sun's Motion, but the *Moveable* ones were governed by the Moon's Motion, as the *Fixed* and Moveable Feasts *N. S.* are now governed; especially *Easter*, on which the rest depend. *God* ordained that the Feast of the *Jewish Passover*, should be kept on the 14th Day of the first *Lunar* Month at Even (*see* Levit. *Chap.* xiii.) which was at the Time of the first *Full Moon* in the first Month. But the *Christian* Church ordained the Celebration of *Easter* on the *Sunday* following; because our Saviour rose upon that Day. The Primitive Fathers had no Way of determining the Time of the New-Moon, but by observing it, emerging out of the Sun's Rays at *Even*, which was a Day after Conjunction. The Council of *Nice*, *Anno* 325, settled the Fall of *Easter* by the *Metonic* Cycle of Moons, (so called from it's Inventor *Meton*) as in the *Ecclesiastical Kalendar*; inserting the Order of their happening there. They supposed that, in every Succession of 19 *Julian* Years (the *Period* they allotted to the *Lunar*-Cycle) the Moons would return on the same Days of the Months, and Hours of the Day, as in the Order of the *Golden Number*, pointing out the New-Moons, in the *Bible-Calendar*: Which, besides Anticipation, is incompatible, by the odd Hours not reckoned for the last 3 common Years. Those *Ecclesiastical* New-Moons (reckoned from and to Leap-Year) were about five Days later than the Time of the *true* ones, according to *O. S.* before it's Alteration to the New Hereby *Easter* came not to be observed according to the Time of it's original Institution. [*The next* Sunday *after the first Full-Moon happening next after the 21st of* March, or *Vernal Æquinox*, tho' at the Time of the *Nicene* Council happening on the 20th, but before the Stile was altered and the New *Style* took Place, in 1752, on the 9th of *March*.] If the Celebration of *Easter* had been ordered on the *next* Sunday *after the first true Full-Moon happening next after the Time of the Vernal Æquinox*, it would always have been observed according to it's first Institution.

The *Anticipation* of the *Vernal Æ*quinox *O. S.* (and of the Seasons or any Points of the Ecliptic) was $44^m\ 9^s\ 21^{th}$ every four *Julian* Years, by reckoning so much more Time than was contained in four *Solar Years* (each Year, according to Sir *Isaac Newton*, being about $365^d\ 5^h\ 48^m\ 57^s\ 39^{th}$) by which in 33 Leap Years to come, the Time of the Vernal *Æquinox* would be $1^d\ 0^h\ 17^m\ 8^s$ sooner. And, in 356 *Leap*-Years backward from 1748, since the *Leap*-Year 324 (preceding the Year 325, the Time of the *Nicene* Council) the Anticipation was $10^d\ 21^h\ 59^m\ 32^s$. The *Æquinox*, *Anno* 324, being on *March* $19^d\ 15^h\ 29^m$, and consequently *Anno* 325 on *March* 19th, $21^h\ 18^m$. Also, in the Year before Christ, being *Bissextile*, the *Vernal Æ*quinox was *March* $22^d\ 3^h\ 6^m$ P. M. and therefore *Anno* Christi 1, it was $22^d\ 8^h\ 55^m$, nearly agreeing with the Time by the *Caroline* Tables of March 22, $7^h\ 22^m$. *Three Years after each Leap-Year, the Æquinox and Seasons went forward, at the Rate of* $5^h\ 48^m\ 57^s\ 39^{th}$, &c. *each Year*; the Year of 365 Days, under-reckoning the solar-Year till every fourth Year of 366 Days, which over-reckon'd what Time was lost, by $44^m\ 9^s$, *&c.* and then brought back, or retrograded the Seasons again.

The *Ancients* supposed that 235 Lunations exactly completed the *Lunar* Cycle of 19 Years: But 235 Lunations, allowing $29^d\ 12^h\ 44^m\ 3^s\ 29^{th}$, *&c.* to each, are equal to $6939^d\ 16^h\ 34^m\ 17^s$. And 19 *Julian* Years, of $365^d\ 6^h$ each, are equal to $6939^d\ 18^h$. Therefore the Difference, $1^h\ 25^m\ 43^s$, was the *Lunar*-Anticipation in 19 *Julian* Years: Four Times that Time, $5^h\ 42^m\ 52^s$, was the proper *Lunar*-Anticipation for 19 *Leap*-Years. For it is to be observed, that every 1, 2, 3 common Years after each *Leap*-Year, the Mean New-Moons anticipated or happened sooner by $10^d\ 15^h\ 11^m$, $21^d\ 6^h\ 22^m$, $2^d\ 8^h\ 42^m$, respectively, than the New-Moons in the same Months in the *Leap*-Year preceeding: The 6 Hours above 365 Days in each *Julian* Year being counted but once in 4 Years. The Mean New-Moons anticipated $14^d\ 0^h\ 1^m$ in every four *Julian* Years; therefore in four *Leap*-Years, or 16 *Julian*, the *Lunar*-Anticipation was $56^d\ 0^h\ 4^m$ from whence deducting a Lunation $= 29^d\ 12^h\ 44^m$, there remain $26^d\ 11^h\ 20^m$, the nearest Anticipation; to which adding the third common Year's Anticipation after *Leap*-Year, *viz.* $2^d\ 8^h\ 49^m$, the Sum is $28^d\ 20^h\ 9^m$, Anticipation at the End of four *Leap* and three common Years: The Mean New-Moons then happening so much sooner in the Months, than in the preceding 19th Year.

Say $1^h\ 25^m\ 43^s : 19^{th} : 24^h$. 319 *Julian* Years, or 79 *Leap*, three common, and 18 Hours, when the *Lunar*-Anticipation is a Day; consequently, in 1424 *Julian*, or 356 *Leap*-Years, since the *Leap*-Year, preceding the *Nicene*-Council to 1748, the *Lunar*-Anticipation was about four Days, eleven Hours; if to which one Day be added, the Time when the *New*-Moons were observed, later than they really happened, at the *Nicene*-Council, will make almost five Days and a half difference; which accounts for the Difference between the *Ecclesiastical* and true Moons, before the Alteration of Stile, and Correction of the Calendar. *N. B.* The greatest Difference of Time between a Mean and True Conjunction, or Opposition, is, about 14 Hours.

In the *Victorian*, or *Dyonisian*-Period of 532 Years, the *New* and *Full*-Moons were supposed by the Antients to return on the same Days of the Month, and also on the same Week-Days, which Error has been shewn; there being a Day *Lunar*-Anticipation in that Time: Yet the *Period* is still retained for it's Use in *History* and *Chronology*.

Sir *Isaac Newton*, in his Account of the Birth and Passion of *Christ*, printed *Anno* 1733, observes that the *Primitive* Christians had little Regard to the Times of the *Birth* and Passion of our Saviour, as being not material to *Religion*; though there since has been such a Strictness observed in the Keeping the Times of the *Fasts* and *Festivals*. They were first celebrated on the *Cardinal* Points of the Year. The *Annunciation* on 25th of *March*, the Time of the Vernal Æquinox, when *Julius Cæsar* corrected the *Calendar*. The Feast of St. *John* on *June* 24th, the Time of the Summer Solstice. St. *Michael* on *September* 29, the Time of the Autumnal Æquinox; and the Birth of Christ on *December* 25, then the Day of the Winter Solstice. The Feast of St. *Thomas* on *December* 20; St. *Matthias* on the 21st of *September*; and the other *Saints* on the Sun's Entrance into the different *Signs*; as may be read.

He fixes the first Passover in the 16th Year of *Tiberius*, in the 4728th Year of the *Julian*-Period, between the Baptism of *Christ*, and Imprisonment of *John*. The second, four Months after St. *John*'s Imprisonment, and *Christ*'s beginning to preach in *Galilee*. The third *Passover* was the Feast following that when the Corn was eared and ripe. And the Fifth, at the Time in which Christ suffered. He thence concludes that the Time of Crucifixion to be in the 34th Year from the Incarnation, or in 33d Year from the Time of the Birth.

PERPETUAL

TIME-TABLES:

OR

General RULES for CHRONOLOGISTS, HISTORIANS, MEMORANDUM-BOOK-MAKERS, TRAVELLERS, and NAVIGATORS. Determining, *at Sight*, the POINTS of TIME, for any one *Season* or YEAR, *past, present*, or *to come*. *Particularly* useful for all Persons writing ALMANACS for the STATIONERS COMPANY.

WHICH TABLES (of themselves) are no more a CALENDAR, or ALMANAC, serving for any one *Season*, or *Time*, than the Timber cut out in a *Dock-Yard* for Building, but not united into Form, is a SHIP; or *no more so* than Timber framed for Building, is a *House*; or than RULES for making ALMANACS is an ALMANAC. And therefore these TABLES or RULES are not subject to *Stamp-duty*; since all *Rules of Art*, for making any *Performance*, are allowable, without Restraint: For, without Rules to make them, there could be *no Almanacs*.

This *Truth* we think ourselves obliged to explain, as the *Stamp-Office* has a Right, by Act of Parliament, to charge a Duty on what is *literary* and *truly an* ALMANAC for any one Time, or Number of Times: or on *what* **chiefly** *serves that Purpose, for any one Time, or Number of Times*, to come: Since every printed *Figure* or *Letter*, or even the *Paper* of any Book of Chronology, and especially all *chronological Rules*, may *partly* serve that Purpose. In which Sense of **chiefly** *serving that Purpose* of an ALMANAC, for any one Time, or particular Number of Times, for the Year or Season, or Years or Seasons, present, or to come, the **Act takes Place,** and no further.

But, our *Tables* consist of *general* RULES, not serving *chiefly*, or made for any *one* Time, or Number of Times, or Years, present or to come, but *generally* (and not *chiefly*) serve, for all *past* and *future* TIME, and for no Year or Season, or Years and Seasons, in particular: And of which Time, in general, as *infinite Duration*, no particular Year or Years, Season or Seasons, can be understood. So that our *Perpetual Tables* are only subservient (like all other *general Rules*) to the *general*, and therein particular, Uses for which *they were wanted and designed*.

For *Time*, though in *Eternity* applied
To Motion, measures all Things durable
By present, past, and future. ——

MILTON b. V. l. 580.

RULES for CHRONOLOGISTS, HISTORIANS, &c.

RULES *for finding the Moveable* FEASTS *and* HOLIDAYS.

EASTER, on which the Rest depends, is always the *1st Sunday* after the first *F. Moon*, happening upon, or next after, *March* 21; and if the F. M. is on a *Sunday*, *Easter* is the *Sunday* following.

Septuagesima S.	9 Weeks	before Easter.	*Rogation-Sunday*	5 Wks	after Easter.
Sexagesima	8 Weeks	before Easter.	*Ascension-day*	40 Ds	after Easter.
Quinquagesima	7 Weeks	before Easter.	*Whitsunday*	7 Wks	after Easter.
Quadragesima	6 Weeks	before Easter.	*Trinity Sunday*	8 Wks	after Easter.

ADVENT SUNDAY the *nearest Sund.* to the Feast of St *Andrew*.

All the moveable and fixed FEASTS *observed in the Church of* England.

All Sundays	St. Barnabas	St. Andrew Ap.
Circumcision	Nat. St. J. Bap.	St. Thomas Ap.
Epiphany	St. Peter Ap.	Nat. of Christ
Conv. St. Paul	St. James Ap.	St. Stephen Mar.
Purification V. M.	St. Barth. Ap.	St. John Evan.
St. Matthias	St. Matth. Ap.	Holy Innocents
Annun. V. Mary	St. Mic. & all An.	Mo. & Tu. in East.
St. Mark Evan.	St. Luke Ev.	Mo. & Tu. in Whit.
St. Ph. and Ja. Ap	St. Sim. & Ju. Ap.	
Ascension J. Chr.	All Saints	

VIGILS *and* FASTS.

Eve or Vigil before	*Nat. Chr.*	*Pentecost*	*St. James*	*St. Andrew*
	Purif.	*St. Matthias*	*St. Barthclom.*	*St. Thomas*
	Easter Day	*St. John Bap.*	*St. Matthew*	*All Saints.*
	Ascension	*St. Peter*	*St. Sim. & Jude*	

N. B. When a *Feast-day* falls on a *Monday*, the Vigil or Fast is kept on the *Saturday-Eve* preceding, and not on that of the *Sunday*, which is a *Feast-day*.

DAYS *of* FASTING *and* ABSTINENCE.

I. Forty Days in Lent.

II. The Ember Days, at the 4 SEASONS, on the *Wednesday*, *Friday* and *Saturday* after the *1st Sunday in Lent*, *Feast of Pentecost*, *September the 14th*, *December the 13th*.

III. The 3 *Rogation-days*, *Monday*, *Tuesday*, *Wednesday*, before Christ's Ascension or *Holy Thursday*.

IV. All the *Fridays* in the Year, except *Christmas-day*.

Solemn Days *kept, for which particular* Church-Service is *appointed*.

I. *November* 5, in Memory of the *Popish Plot*.

II. *January* 30, in Memory of the Martyrdom of K. *Charles* I.

III. *May* 29, in Memory of the Birth and Return of K. *Charles* II.

Hil. T. b. Jan. 23. ends Feb. 12		*Michaelmas T. beg. Nov. 6, ends*	*Nov. 29*
1 Return	*Jan.* 20	1 Return	*Nov.* 3
2 Return	27	2 Return	12
3 Return	*Feb.* 3	3 Return	18
4 Return	9	4 Return	25
Easter Term		*Trinity Term.*	
1 Ret. 14 Days	from Easter exclusive.	1 Ret. Morrow of Hol. Tr.	
2 Ret. 21	from Easter exclusive.	2 Ret. 7 Days	Fr. Holy Trinity, exclusive.
3 Ret. 28	from Easter exclusive.	3 Ret. 14	Fr. Holy Trinity, exclusive.
4 Ret. 35	from Easter exclusive.	4 Ret. 21	Fr. Holy Trinity, exclusive.
5 Ret. on Morrow of Ascen.			

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

MOVEABLE FEASTS for ever, according to the Fall of EASTER, N. S.

Easter Sunday.	Septuagesima Sunday	Ash-Wednes.	Rogat. Sunday.	Ascen. Sunday.	Whit-Sunday.	Advent Sunday.
Mar. 22	Jan. 18	Feb. 4	Apr. 26	Apr. 30	May 10	Nov. 29
23	19	5	27	May 1	11	30
24	20	6	28	2	12	Dec. 1
25	21	7	29	3	13	2
26	22	8	30	4	14	3
27	23	9	May 1	5	15	Nov. 27
28	24	10	2	6	16	28
29	25	11	3	7	17	29
30	26	12	4	8	18	30
31	27	13	5	9	19	Dec. 1
Apr. 1	28	14	6	10	20	2
2	29	15	7	11	21	3
3	30	16	8	12	22	Nov. 27
4	31	17	9	13	23	28
5	Feb. 1	18	10	14	24	29
6	2	19	11	15	25	30
7	3	20	12	16	26	Dec. 1
8	4	21	13	17	27	2
9	5	22	14	18	28	3
10	6	23	15	19	29	Nov. 27
11	7	24	16	20	30	28
12	8	25	17	21	31	29
13	9	26	18	22	June 1	30
14	10	27	19	23	2	Dec. 1
15	11	28	20	24	3	2
16	12	Mar. 1	21	25	4	3
17	13	2	22	26	5	Nov. 27
18	14	3	23	27	6	28
19	15	4	24	28	7	29
20	16	5	25	29	8	30
21	17	6	26	30	9	Dec. 1
22	18	7	27	31	10	2
23	19	8	28	June 1	11	3
24	20	9	29	2	12	Nov. 27
25	21	10	30	3	13	28

N. B. When any *Feasts* fall in *January* or *February* in *Leap-Year*, such Feasts must be taken a *Day later* than by Table.

To find the Golden Number for any Year?

Add 1 to the Date, and divide the Sum by 19, what remains is the Golden Number required.

When 0 remains 19 is the Golden Number.

The above Rule is here repeated for Use.

MOVEABLE TERMS for ever, according to the Fall of EASTER, N. S.

Easter Term begins.	Ends.	Trinity Term begins.	Ends.
Apr. 8	May 4	May 22	June 10
9	5	23	11
10	6	24	12
11	7	25	13
12	8	26	14
13	9	27	15
14	10	28	16
15	11	29	17
16	12	30	18
17	13	31	19
18	14	June 1	20
19	15	2	21
20	16	3	22
21	17	4	23
22	18	5	24
23	19	6	25
24	20	7	26
25	21	8	27
26	22	9	28
27	23	10	29
28	24	11	30
29	25	12	July 1
30	26	13	2
May 1	27	14	3
2	28	15	4
3	29	16	5
4	30	17	6
5	31	18	7
6	June 1	19	8
7	2	20	9
8	3	21	10
9	4	22	11
10	5	23	12
11	6	24	13
12	7	25	14

N. B. Easter-Term begins 17 Days, and ends 43 Days after EASTER. *Trinity*-Term begins 5 Days, and ends 24 Days after *Trinity*. Therefore *Easter*-Term continues 27 and *Trinity* 20, inclusive.

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

MOVEABLE FEASTS from 1759 to 1800, N. S.

Years of Christ.	Gol. No.	Dom. Letter. N. S.	Dom. Letter. O. S.	Septuagesima Sunday	Ash-Wednes.	Easter Sunday.	Rogat. Sunday.	Ascens. Day.	Whit-Sunday.	Advent Sunday.	Epact.
1759	12	G	C	Feb. 11	Feb. 28	Apr. 15	May 20	May 24	Jun. 3	2	1
B. 1760	13	F E	B A	3	20	6	11	15	May 25	Nov. 30	12
1761	14	D	G	Jan. 18	4	Mar. 22	Apr. 26	Apr. 30	10	29	23
1762	15	C	F	Feb. 7	24	Apr. 11	May 16	May 2	30	28	4
1763	16	B	E	Jan. 30	16	3	8	12	22	27	15
B. 1764	17	A G	D C	Feb. 19	Mar. 7	22	27	31	Jun. 10	Dec. 2	26
1765	18	F	B	3	Feb. 20	7	12	16	May 26	1	7
1766	19	E	A	Jan. 20	12	Mar. 30	4	8	18	Nov. 30	18
1767	1	D	G	Feb. 15	Mar. 4	Apr. 19	24	28	Jun. 7	29	0
B. 1768	2	C B	F E	Jan. 31	Feb. 17	3	8	12	May 22	27	11
1769	3	A	D	22	8	Mar. 20	Apr 30	4	14	Dec. 3	22
1770	4	G	C	Feb. 11	28	Apr. 15	May 20	24	Jun. 3	2	3
1771	5	F	B	Jan. 27	13	Mar. 31	5	9	May 19	1	14
B. 1772	6	E D	A G	Feb. 16	Mar. 4	Apr. 19	24	28	Jun. 7	Nov. 29	25
1773	7	C	F	7	Feb. 24	11	16	20	May 30	28	6
1774	8	B	E	Jan. 30	16	3	8	12	22	27	17
1775	9	A	D	Feb. 12	Mar. 1	16	21	25	Jun. 4	Dec. 3	28
B. 1776	10	G F	C B	4	Feb. 21	7	12	16	May 26	1	9
1777	11	E	A	Jan. 20	12	Mar. 30	4	8	18	Nov. 30	20
1778	12	D	G	Feb. 15	Mar. 4	Apr. 19	24	28	Jun. 7	29	1
1779	13	C	F	Jan. 31	Feb. 17	4	9	13	May 23	28	12
B. 1780	14	B A	E D	23	9	Mar. 26	Apr. 30	4	14	Dec. 3	23
1781	15	G	C	Feb. 11	28	Apr. 15	May 20	24	Jun. 5	2	4
1782	16	F	B	Jan. 27	13	Mar. 31	5	9	May 19	1	15
1783	17	E	A	Feb. 16	Mar. 5	Apr. 20	25	29	Jun. 8	Nov. 30	26
B. 1784	18	D C	G F	8	Feb. 25	11	16	20	May 30	28	7
1785	19	B	E	Jan. 23	9	Mar. 27	1	5	15	27	18
1786	1	A	D	Feb. 12	Mar. 1	Apr. 16	21	25	Jun. 4	Dec. 3	0
1787	2	G	C	4	Feb. 21	8	13	17	May 27	2	11
B. 1788	3	F E	B A	Jan. 20	6	Mar. 23	Apr. 27	1	11	Nov. 30	22
1789	4	D	G	Feb. 8	25	Apr. 12	May 17	21	31	29	3
1790	5	C	F	Jan. 31	17	4	9	13	23	28	14
1791	6	B	E	Feb. 20	Mar. 9	24	29	June 2	Jun. 12	27	25
B. 1792	7	A G	D C	5	Feb. 22	8	13	May 17	May 27	Dec. 2	6
1793	8	F	B	Jan. 27	13	Mar. 31	5	9	19	1	17
1794	9	E	A	Feb. 16	Mar. 5	Apr. 20	25	29	Jun. 8	Nov. 30	28
1795	10	D	G	1	Feb. 18	5	10	14	May 24	29	9
B. 1796	11	C B	F E	Jan. 24	10	Mar. 27	1	5	15	27	20
1797	12	A	D	Feb. 12	Mar. 1	Apr. 16	21	25	Jun. 4	Dec. 3	1
1798	13	G	C	Feb. 4	Feb. 21	8	13	17	May 27	2	12
1799	14	F	B	Jan. 20	6	Mar. 24	Apr. 28	2	12	1	23
1800	15	E	A G	Feb. 9	26	Apr. 13	May 18	22	Jun. 1	Nov. 30	4

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

JANUARY xxxi Days.

G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Stile.*
m	t	w	th	f	ſ	S	1	CIRCUMCISION. DayBr. $5^h 59^m$. T. e.
t	w	th	f	ſ	S	m	2	Sun riſes 8 4, ſets 3 56, *Lond*[6h 1m.
w	th	f	ſ	S	m	t	3	
th	f	ſ	S	m	t	w	4	Sir *Iſaac Newton* born, 1643, N. S.
f	ſ	S	m	t	w	th	5	Old Chriſtmas-day.
ſ	S	m	t	w	th	f	6	EPIPHANY.
S	m	t	w	th	f	ſ	7	Sun ſlow of Clocks 7m 10s.
m	t	w	th	f	ſ	S	8	Lucian.
t	w	th	f	ſ	S	m	9	
w	th	f	ſ	S	m	t	10	Princeſs Elizabeth born, 1740.
th	f	ſ	S	m	t	w	11	Day Break 5 22. Tw. ends 6 8.
f	ſ	S	m	t	w	th	12	Sun riſes 7 56, ſets 4 5.
ſ	S	m	t	w	th	f	13	St. *Hillary*, Biſhop of Poictiers.
S	m	t	w	th	f	ſ	14	Ox. & Cam. Terms begin.
m	t	w	th	f	ſ	S	15	Exchequer opens.
t	w	th	f	ſ	S	m	16	
w	th	f	ſ	S	m	t	17	OldTwelfth-day. ☉ ſl. of Cl. $10^m 56^s$.
th	f	ſ	S	m	t	w	18	Priſca.
f	ſ	S	m	t	w	th	19	Sun enter'd ♒, Noon, 1756.
ſ	S	m	t	w	th	f	20	*Fabian.*
S	m	t	w	th	f	ſ	21	Agnes. Day Br. 5 43. Tw. e. 6 17.
m	t	w	th	f	ſ	S	22	Vincent. Sun riſes 7 44, ſets 4 16.
t	w	th	f	ſ	S	m	23	Hillary Term begins.
w	th	f	ſ	S	m	t	24	
th	f	ſ	S	m	t	w	25	CONVERSION OF ST. PAUL.
f	ſ	S	m	t	w	th	26	
ſ	S	m	t	w	th	f	27	Sun ſlow of Clocks 13m 29s.
S	m	t	w	th	f	ſ	28	
m	t	w	th	f	ſ	S	29	
t	w	th	f	ſ	S	m	30	K. CHA. II. MAR. 1648-9, O. S.
w	th	f	ſ	S	m	t	31	[12m paſt One.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	30	7	15	23	7	24	1 31	9	17	13	17	25	3	10
2	19	26	4	12	8	12	20	27	5	14	6	14	21	29
3	8	16	23	1 31	9	1 31	9	16	24	15	25	3	11	18
4	26	4	11	19	10	20	28	6	13	16	14	21	29	6
5	16	23	1 31	8	11	10	17	25	3	17	3	11	18	25
6	5	12	20	27	12	28	6	13	20	18	22	29	7	15
										19	11	18	26	4

☞ *Under the Dom. Letter for O. or N. Stile, againſt the Day of the Month ſtands the Week-Day Letter correſpondent.*

⁂ *Oxford and Cambridge Terms end Thurſday before Whitſunday—Trinity College Election on Trinity Monday.*

FEBRUARY xxviii or xxix Days.

G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
th	f	ſ	S	m	t	w	1	Sun riſes 7 26, ſets 4 34, *London.*
f	ſ	S	m	t	w	th	2	PURIF. V. MARY, or Candlemas-day.
ſ	S	m	t	w	th	f	3	Blaize, Biſhop.
S	m	t	w	th	f	ſ	4	
m	t	w	th	f	ſ	S	5	Agatha.
t	w	th	f	ſ	S	m	6	
w	th	f	ſ	S	m	t	7	Sun ſlow of Clocks 14m 43s.
th	f	ſ	S	m	t	w	8	
f	ſ	S	m	t	w	th	9	
ſ	S	m	t	w	th	f	10	*Dies Scholaſtica*, at Oxford.
S	m	t	w	th	f	ſ	11	Day Br. 5 12. Tw. ends 6 48.
m	t	w	th	f	ſ	S	12	Hillary T. ends. Sun r. 7 8. ſ. 4 52.
t	w	th	f	ſ	S	m	13	Old Candlemas-day.
w	th	f	ſ	S	m	t	14	*Valentine*, a Biſhop of Rome & M.
th	f	ſ	S	m	t	w	15	
f	ſ	S	m	t	w	th	16	
ſ	S	m	t	w	th	f	17	Sun ſlow of Clocks, 14m 29s
S	m	t	w	th	f	ſ	18	Sun in ♓ 21′ Noon, 1756.
m	t	w	th	f	ſ	S	19	
t	w	th	f	ſ	S	m	20	
w	th	f	ſ	S	m	t	21	Day Br. 4 55. Twil. ends 7 5.
th	f	ſ	S	m	t	w	22	Sun riſes 6 49, ſets 5 11.
f	ſ	S	m	t	w	th	23	
ſ	S	m	t	w	th	f	24	St. MATTHIAS.
S	m	t	w	th	f	ſ	25	
m	t	w	th	f	ſ	S	26	
t	w	th	f	ſ	S	m	27	Sun ſlow of Clocks 13m 4s
w	th	f	ſ	S	m	t	28	Hare-Hunting goes out.
th	f	ſ	S	m	t	w	29	Leap-Year.
								Camb. Com. for B. A. the Day after Aſh-Wedneſday.

The NEW, FULL, and QUARTER MOONS.

Gol. Nº.	N M ●	F Q ☽	F M ○	L Q ☾	Gol. Nº.	N M ●	F Q ☽	F M ○	L Q ☾	Gol. Nº.	N M ●	F Q ☽	F M ○	L Q ☾
1	28	6	13	21	7	22	—	8	15	13	16	23	1	9
2	17	25	3	10	8	11	18	25	3	14	5	13	20	27
3	7	14	22	29	9	—	8	15	23	15	24	2	9	17
4	25	3	10	17	10	19	27	4	12	16	12	20	27	5
5	14	22	29	7	11	8	16	23	1	17	2	9	16	24
6	3	11	18	26	12	26	4	11	19	18	20	8	6	13
										19	10	18	25	3

☞ *Oxford and Cambridge Terms begin Wedneſday after Trinity Sunday—Trinity College Election, Monday after Trinity Sunday.*

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

MARCH xxxi Days.

	G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
	th	f	ſ	S	m	t	w	1	S DAVID, Abp.M.b.4 41.T.e.7 20
	f	ſ	S	m	t	w	th	2	Cedde or Chad. B. Sun r.6 34 ſ.5 27
	ſ	S	m	t	w	th	f	3	
	S	m	t	w	th	f	ſ	4	Sun ſlow of Clocks 12m 1s.
	m	t	w	th	f	ſ	S	5	*Princeſs Mary of Heſſe b.* 1722.
	t	w	th	f	ſ	S	m	6	
	w	th	f	ſ	S	m	t	7	Perpetua Maurit. Mart.
	th	f	ſ	S	m	t	w	8	*Camb. latter Act Thurſ. af.* 4 *S. in*
	f	ſ	S	m	t	w	th	9	*Lent.*
	ſ	S	m	t	w	th	f	10	Day br. 4 19. Twil. ends 7 42.
	S	m	t	w	th	f	ſ	11	Sun riſes 6 14, ſets 5 47.
	m	t	w	th	f	ſ	S	12	Gregory.
	t	w	th	f	ſ	S	m	13	
	w	th	f	ſ	S	m	t	14	Sun ſlow of Clocks 9m 21s.
	th	f	ſ	S	m	t	w	15	*Oxf. & Cam. Terms end the Day bef.*
	f	ſ	S	m	t	w	th	16	*Palm S.*
	ſ	S	m	t	w	th	f	17	St. Patrick, a Biſhop of Ireland.
	S	m	t	w	th	f	ſ	18	Ed. K. of Weſt Sax.
	m	t	w	th	f	ſ	S	19	Prſſe Louiſa-Ann b. 1749. Joſeph.
	t	w	th	f	ſ	S	m	20	Cuthbert. Equal Day and Night.
14	w	th	f	ſ	S	m	t	21	Benedict Abbot. D.b.3 57.T.e.8 4.
3	th	f	ſ	S	m	t	w	22	Sun riſes 5 54, ſets 6 7.
	f	ſ	S	m	t	w	th	23	Sun in ♈ 20′ on 20 D. Noon, 1756.
11	ſ	S	m	t	w	th	f	24	Sun ſlow of Clocks 6m 18s.
	S	m	t	w	th	f	ſ	25	LADY-DAY. ANNUNCIATION B.
19	m	t	w	th	f	ſ	S	26	[V. M. *Pr. Edward b.* 1739.
8	t	w	th	f	ſ	S	m	27	*N. B. According to* Gregorian
	w	th	f	ſ	S	m	t	28	*Reckoning, the Golden Numbers to the*
16	th	f	ſ	S	m	t	w	29	*Left of all, ſhew the Times of the*
5	f	ſ	S	m	t	w	th	30	*Full Moons preceding* Eaſter-Sunday,
	ſ	S	m	t	w	th	f	31	*till* 1900.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	30	8	15	23	7	23	1 30	8	16	13	17	25	3	10
2	19	27	5	12	8	12	20	27	5	14	7	13	22	29
3	7	15	22	30	9	1 31	9	16	24	15	24	2	10	17
4	26	4	11	19	10	21	28	6	14	16	14	21	29	6
5	16	23	1 31	8	11	9	17	24	1 31	17	3	11	18	26
6	5	13	20	28	12	28	6	13	21	18	22	30	7	15
										19	10	18	25	3

N. B. Corpus Chriſt Th. af. Tr. S. — Cam. Commencement 1ſt Tueſd. July.

The above is not a [illegible] count for Easter —

APRIL xxx Days.

	G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
13	S	m	t	w	th	f	ſ	1	All Fools-day. D. b. 3 31. T. e.
2	m	t	w	th	f	ſ	S	2	Sun riſes 5 32, ſets 6 28. [8 29.
	t	w	th	f	ſ	S	m	3	Richard B. Chich.
10	w	th	f	ſ	S	m	t	4	S. Ambroſe. Sun ſl. of Cl. 2m 55s.
	th	f	ſ	S	m	t	w	5	Old Lady day.
18	f	ſ	S	m	t	w	th	6	*Oxf. & Cam. Terms beg. Wed. af.*
7	ſ	S	m	t	w	th	f	7	*1ſt S. aft. Eaſter.*
	S	m	t	w	th	f	ſ	8	
15	m	t	w	th	f	ſ	S	9	
4	t	w	th	f	ſ	S	m	10	D. br. 3 34. T. e. 8 57.
	w	th	f	ſ	S	m	t	11	Sun riſes 5 13, ſets 6 48.
12	th	f	ſ	S	m	t	w	12	*Eaſter Ter. beg.* 17 *Days af. Eaſter,*
1	f	ſ	S	m	t	w	th	13	*ends in* 17 *Days.*
	ſ	S	m	t	w	th	f	14	Sun ſlow of Clocks 0m 16s.
9	S	m	t	w	th	f	ſ	15	Sun and Clocks together.
	m	t	w	th	f	ſ	S	16	*Weſtminſter Election Day af.* 4 *S. af.*
17	t	w	th	f	ſ	S	m	17	*Eaſter.*
6	w	th	f	ſ	S	m	t	18	[*in* 20 *Days.*
	th	f	ſ	S	m	t	w	19	Alphege. *Tr. T. beg.* 5 *Ds af. Ea. ends*
	f	ſ	S	m	t	w	th	20	Sun in ♉ 46′ Noon, 1756.
	ſ	S	m	t	w	th	f	21	Day Br. 2 37. Tw. ends 9 24.
	S	m	t	w	th	f	ſ	22	Sun riſes 4 54, ſets 7 7.
	m	t	w	th	f	ſ	S	23	S. Geo. of Cappadocia, Patr. Eng.
	t	w	th	f	ſ	S	m	24	Sun faſt of Clocks 2m 6s.
	w	th	f	ſ	S	m	t	25	St. MARK, Evangeliſt.
	th	f	ſ	S	m	t	w	26	DUKE OF CUMBERLAND, b. 1721.
	f	ſ	S	m	t	w	th	27	Vict. of Culloden.
	ſ	S	m	t	w	th	f	28	*N.B. According to the* Greg. *Reckon-*
	S	m	t	w	th	f	ſ	29	*ing, the Gold. Nos. to the Left of all,*
	m	t	w	th	f	ſ	S	30	*ſhew the Times of the Full Moons pre-*
									ceding Eaſter Sunday, *till* 1900.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	28	6	13	21	7	22	29	7	14	13	11	23	1 30	8
2	18	25	3	11	8	11	19	26	3	14	5	13	20	28
3	6	14	21	28	9	30	8	15	23	15	23	1 30	8	10
4	25	3	10	18	10	19	27	4	12	16	13	20	27	5
5	14	22	29	7	11	7	15	22	30	17	2	9	17	24
6	4	11	18	26	12	27	4	12	19	18	21	28	6	14
										19	9	17	24	2

N. B. The Rules for variable Days are in the Body of the Months from January to April, and then in Succeſſion from January to April at the Bottom.

⁂ *Oxf. Act.* 7 *Days fr. Cam. Commencement. — Baliol. Col. Election Th. bef. St. Andrew.*

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

MAY xxxi Days.

F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
w	th	f	ſ	S	m	1	St. PHIL. & JAMES. D. br. 2 2. T. E.
th	f	ſ	S	m	t	2	Sun riſes 5 36, ſets 7 25. [9 59.
f	ſ	S	m	t	w	3	Invention of the Croſs.
ſ	S	m	t	w	th	4	Sun faſt of Clocks 3m 33s.
S	m	t	w	th	f	5	
m	t	w	th	f	ſ	6	St. John Evang. ante Port. Lat.
t	w	th	f	ſ	S	7	
w	th	f	ſ	S	m	8	
th	f	ſ	S	m	t	9	
f	ſ	S	m	t	w	10	
ſ	S	m	t	w	th	11	Day br. 1 24. Twil. ends 10 38.
S	m	t	w	th	f	12	Old May-day. Sun r. 4 19, ſ. 7 42.
m	t	w	th	f	ſ	13	
t	w	th	f	ſ	S	14	Sun faſt of Clocks 4m 2s.
w	th	f	ſ	S	m	15	
th	f	ſ	S	m	t	16	
f	ſ	S	m	t	w	17	
ſ	S	m	t	w	th	18	
S	m	t	w	th	f	19	Dunſtan.
m	t	w	th	f	ſ	20	Sun in ♊ 44′ on 21 D. Noon, 1756.
t	w	th	f	ſ	S	21	Day br. 0 12. Twil. ends 11 49.
w	th	f	ſ	S	m	22	Sun riſes 4 5, ſets 7 55.
th	f	ſ	S	m	t	23	
	ſ	S	m	t	w	24	*Pr. Fred. Will. b.* 1750. Sun faſt of Cl.
	S	m	t	w	th	25	[3m 36s.
	m	t	w	th	f	26	Auguſtine. No Night.
	t	w	th	f	ſ	27	Venerable Bede.
	w	th	f	ſ	S	28	
	th	f	ſ	S	m	29	K. CHARLES II's NAT. and RESTOR.
	f	ſ	S	m	t	30	
	ſ	S	m	t	w	31	

The NEW, FULL, and QUARTER MOONS.

N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
28	6	13	21	7	21	29	6	14	13	15	23	1 30	8
17	25	3	10	8	10	18	25	3	14	5	12	19	27
6	13	20	28	9	29	17	15	22	15	23	30	8	15
4	2	10	17	10	19	27	4	12	16	12	19	26	4
14	21	28	6	11	7	15	22	29	17	1 31	9	16	24
3	11	18	26	12	26	4	11	19	18	20	18	6	13
									19	9	16	23	1 31

JUNE xxx Days.

G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
f	ſ	S	m	t	w	th	1	Nicomedes. No Night.
ſ	S	m	t	w	th	f	2	Sun riſes 3 52, ſets 8 8.
S	m	t	w	th	f	ſ	3	
m	t	w	th	f	ſ	S	4	*George Prince of Wales born*, 1738.
t	w	th	f	ſ	S	m	5	Boniface. Sun faſt of Clocks 2m 1s.
w	th	f	ſ	S	m	t	6	
th	f	ſ	S	m	t	w	7	
f	ſ	S	m	t	w	th	8	
ſ	S	m	t	w	th	f	9	
S	m	t	w	th	f	ſ	10	*Prſſ. Amelia b.* 1711.
m	t	w	th	f	ſ	S	11	St. BARNABAS.
t	w	th	f	ſ	S	m	12	Sun riſes 3 45, ſets 8 15. No Nt.
w	th	f	ſ	S	m	t	13	
th	f	ſ	S	m	t	w	14	
f	ſ	S	m	t	w	th	15	Sun faſt of Clocks 0m 2s.
ſ	S	m	t	w	th	f	16	Sun and Clocks together.
S	m	t	w	th	f	ſ	17	St. Alban.
m	t	w	th	f	ſ	S	18	
t	w	th	f	ſ	S	m	19	Sun in ♋ 22′ on 21 D. Noon, 1756.
w	th	f	ſ	S	m	t	20	Tranſl. of Edw. K. Weſt Sax.
th	f	ſ	S	m	t	w	21	Sun riſes 3 42, ſets 8 17. No Night.
f	ſ	S	m	t	w	th	22	*K* GEO. II's *Inaug.* Longeſt Day.
ſ	S	m	t	w	th	f	23	
S	m	t	w	th	f	ſ	24	St. JOHN BAPT. born.
m	t	w	th	f	ſ	S	25	Sun fl. of Cl. 2m 5s. St. John's Col. El.
t	w	th	f	ſ	S	m	26	*King* GEORGE II. *proclaimed.*
w	th	f	ſ	S	m	t	27	
th	f	ſ	S	m	t	w	28	
f	ſ	S	m	t	w	th	29	St. PETER.
ſ	S	m	t	w	th	f	30	Buck hunting comes in and continues till Holy Rood. Exeter Col. Elec.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	26	4	11	19	7	20	27	5	12	13	14	21	28	6
2	14	23	1 30	9	8	9	17	24	2	14	3	11	18	26
3	4	12	19	26	9	28	6	13	21	15	21	29	6	14
4	23	1 30	8	16	10	27	25	3	10	16	11	18	25	3
5	12	20	27	5	11	6	13	20	28	17	29	7	14	22
6	1 30	9	17	24	12	24	2	10	17	18	19	26	4	12
										19	7	15	22	29

MENDATIONS. P. 172, Right Hand Col. l. 18. fr. Top. for *ſince Chriſt*, read *before Chriſt*.
P. 177, Right Hand Col. l. 3. fr. Bot. for *Rults*, read *Rules*.
P. 170, Left Hand Col. l. 16. fr. Top. for *required*, read *require*.

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

JULY xxxi Days.

G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
S	m	t	w	th	f	ſ	1	No Night.
m	t	w	th	f	ſ	S	2	Viſit. of B. V. M. Sun r. 3 45, ſ. 8 15.
t	w	th	f	ſ	S	m	3	Dies Comitior.
w	th	f	ſ	S	m	t	4	Tranſ. of St. Mart. B.
th	f	ſ	S	m	t	w	5	Old Midſummer-day.
f	ſ	S	m	t	w	th	6	
ſ	S	m	t	w	th	f	7	Thomas à Becket.
S	m	t	w	th	f	ſ	8	Sun ſlow of Clocks 4m 30s.
m	t	w	th	f	ſ	S	9	
t	w	th	f	ſ	S	m	10	
w	th	f	ſ	S	m	t	11	No Night. Sun riſes 8 52, ſets 8 7.
th	f	ſ	S	m	t	w	12	
f	ſ	S	m	t	w	th	13	
ſ	S	m	t	w	th	f	14	
S	m	t	w	th	f	ſ	15	St. *Swithin*, or Swithun, B. of Winch. [tranſ.
m	t	w	th	f	ſ	S	16	
t	w	th	f	ſ	S	m	17	
w	th	f	ſ	S	m	t	18	Sun ſlow of Clocks 5m 39s.
th	f	ſ	S	m	t	w	19	
f	ſ	S	m	t	w	th	20	Margaret V. and M.
ſ	S	m	t	w	th	f	21	No Night. Sun riſes 4 3, ſets 7 56.
S	m	t	w	th	f	ſ	22	Mary Magdalen. *Prſſe Car. Matilda*
m	t	w	th	f	ſ	S	23	Sun in ♌ 53′ Noon, 1756. [*b.* 1751.
t	w	th	f	ſ	S	m	24	Magdalen Coll. *Election.*
w	th	f	ſ	S	m	t	25	St. JAMES.
th	f	ſ	S	m	t	w	26	St. Ann, Mother B. V. M.
f	ſ	S	m	t	w	th	27	
ſ	S	m	t	w	th	f	28	Sun ſlow of Clocks 5m 56s.
S	m	t	w	th	f	ſ	29	
m	t	w	th	f	ſ	S	30	Dog-days beg. Sirius riſes with the
t	w	th	f	ſ	S	m	31	[Sun.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	26	4	11	19	7	19	27	4	12	13	13	21	28	6
2	15	23	10	8	8	8	16	23	1 31	14	3	10	17	25
3	3	11	18	26	9	27	5	12	30	15	20	28	6	13
4	22	30	8	15	10	17	24	2	10	16	10	18	25	3
5	12	19	26	4	11	5	13	20	27	17	29	7	14	22
6	1 31	9	15	24	12	24	1 31	9	17	18	18	26	3	11
										19	7	14	21	29

AUGUST xxxi Days.

G	F	E	D	C	B	A	Days	*Fixed* Feaſts, *Remarkable Days*, &c. *according to New Style.*
w	th	f	ſ	S	m	t	1	*Lammas-day.* Day br. 1 27.
th	f	ſ	S	m	t	w	2	Sun r. 4 19, ſets 7 40. T. ends 10 31.
f	ſ	S	m	t	w	th	3	
ſ	S	m	t	w	th	f	4	
S	m	t	w	th	f	ſ	5	Sun ſlow of Clocks 5m 31s.
m	t	w	th	f	ſ	S	6	Transfiguration.
t	w	th	f	ſ	S	m	7	Name of Jeſus.
w	th	f	ſ	S	m	t	8	
th	f	ſ	S	m	t	w	9	
f	ſ	S	m	t	w	th	10	St. Laurence, Arch-deac. Rome, &M.
ſ	S	m	t	w	th	f	11	*Princeſs Auguſta* born, 1737.
S	m	t	w	th	f	ſ	12	D. br. 2 5. T. e. 9 53. Sun r. 4 36. [ſ. 7 23.
m	t	w	th	f	ſ	S	13	
t	w	th	f	ſ	S	m	14	
w	th	f	ſ	S	m	t	15	Aſſumption of V. M. Sun ſl. of Cl. [3m 56s.
th	f	ſ	S	m	t	w	16	
f	ſ	S	m	t	w	th	17	
ſ	S	m	t	w	th	f	18	
S	m	t	w	th	f	ſ	19	
m	t	w	th	f	ſ	S	20	
t	w	th	f	ſ	S	m	21	Athanaſius. D. br. 2 38. T. e. 9 21.
w	th	f	ſ	S	m	t	22	Sun riſes 4 54, ſets 7 5.
th	f	ſ	S	m	t	w	23	Sun in ♍ 38′ Noon, 1756.
f	ſ	S	m	t	w	th	24	St. BARTHOLOMEW.
ſ	S	m	t	w	th	f	25	Sun ſlow of Clocks 1m 35s.
S	m	t	w	th	f	ſ	26	
m	t	w	th	f	ſ	S	27	
t	w	th	f	ſ	S	m	28	St. Auſtin B. of Hip.
w	th	f	ſ	S	m	t	29	Beheading St. John Bapt.
th	f	ſ	S	m	t	w	30	Sun and Clocks together.
f	ſ	S	m	t	w	th	31	

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	24	2	9	17	7	18	25	3	11	13	12	19	27	4
2	14	21	28	6	8	7	15	22	29	14	1 31	9	16	24
3	2	10	17	25	9	26	4	11	19	15	19	27	5	12
4	21	28	6	14	10	15	23	1 30	9	16	8	26	23	1 31
5	10	18	25	3	11	4	11	19	26	17	27	5	13	20
6	29	7	14	22	12	22	30	7	15	18	17	24	2	10
										19	5	13	20	28

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

SEPTEMBER xxx Days.

G	F	E	D	C	B	A	Days	*Fixed* Feasts, *Remarkable Days*, &c. *according to New Stile.*
ſ	S	m	t	w	th	f	1	Giles, Abbot. D. br. 3 9. T. e. 8 50.
S	m	t	w	th	f	ſ	2	LONDON burnt 1666, O.S. Sun r. 5 14,
m	t	w	th	f	ſ	S	3	[ſ. 6 44.
t	w	th	f	ſ	S	m	4	
w	th	f	ſ	S	m	t	5	Sun fast of Clocks 1m 45s.
th	f	ſ	S	m	t	w	6	
f	ſ	S	m	t	w	th	7	Eunurchus.
ſ	S	m	t	w	th	f	8	Nativity B. V. M.
S	m	t	w	th	f	ſ	9	Dog-days end. *Canis Major* r. 3 M.
m	t	w	th	f	ſ	S	10	
t	w	th	f	ſ	S	m	11	Day Br. 3 35. Twil. ends 8 24.
w	th	f	ſ	S	m	t	12	Sun rises 5 34, sets 6 25.
th	f	ſ	S	m	t	w	13	
f	ſ	S	m	t	w	th	14	Holy Cross day, or Exalt. of the Cross.
ſ	S	m	t	w	th	f	15	Sun fast of Clocks 5m 11s.
S	m	t	w	th	f	ſ	16	
m	t	w	th	f	ſ	S	17	Lambert B.
t	w	th	f	ſ	S	m	18	
w	th	f	ſ	S	m	t	19	
th	f	ſ	S	m	t	w	20	D. br. 3 58. Twil. ends 8 1.
f	ſ	S	m	t	w	th	21	St. MATTHEW. Sun r. 5 53, ſ. 6 5.
ſ	S	m	t	w	th	f	22	Equal Day and Nt. in all the World.
S	m	t	w	th	f	ſ	23	Sun in ♎ 48′ Noon, 1756.
m	t	w	th	f	ſ	S	24	
t	w	th	f	ſ	S	m	25	Sun fast of Clocks 8m 37s.
w	th	f	ſ	S	m	t	26	St. Cyprian.
th	f	ſ	S	m	t	w	27	
f	ſ	S	m	t	w	th	28	Sheriffs of London sworn.
ſ	S	m	t	w	th	f	29	St. MICHAEL. Hare-hunting comes
S	m	t	w	th	f	ſ	30	St. Jerom. [in and lasts till the End [of Feb.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	23	1 31	8	16	7	16	24	1	9	13	10	18	25	3
2	12	20	27	5	8	5	14	20	28	14	29	7	14	22
3	1 30	8	15	23	9	24	2	10	17	15	18	25	3	11
4	20	27	5	12	10	14	21	28	6	16	7	15	22	29
5	9	17	24	2	11	2	10	17	25	17	26	4	11	19
6	28	5	13	21	12	21	29	6	14	18	15	23	1 30	9
										19	4	11	18	26

OCTOBER xxxi Days.

G	F	E	D	C	B	A	Days	*Fixed* Feasts, *Remarkable Days*, &c. *according to New Style.*
m	t	w	th	f	ſ	S	1	Remegius, B. of Rhemes.
t	w	th	f	ſ	S	m	2	D. br. 4 20. T. e. 7 39. Sun r. 6 13.
w	th	f	ſ	S	m	t	3	[ſ. 5 46.
th	f	ſ	S	m	t	w	4	Sun fast of Clocks, 11m 30s.
f	ſ	S	m	t	w	th	5	
ſ	S	m	t	w	th	f	6	St. Faith, V. & M.
S	m	t	w	th	f	ſ	7	
m	t	w	th	f	ſ	S	8	
t	w	th	f	ſ	S	m	9	St. Denis.
w	th	f	ſ	S	m	t	10	Old Michaelmas-day. Ox. & Cam. T. b.
th	f	ſ	S	m	t	w	11	D. br. 4 40. T. e. 7 19. Sun r. 6 33.
f	ſ	S	m	t	w	th	12	[ſ. 5 22.
ſ	S	m	t	w	th	f	13	Transl. K. Ed. Conf.
S	m	t	w	th	f	ſ	14	Sun fast of Clocks 14m 5s.
m	t	w	th	f	ſ	S	15	
t	w	th	f	ſ	S	m	16	
w	th	f	ſ	S	m	t	17	Etheldred Virg.
th	f	ſ	S	m	t	w	18	St. LUKE the Evangelist.
f	ſ	S	m	t	w	th	19	
ſ	S	m	t	w	th	f	20	
S	m	t	w	th	f	ſ	21	D. br. 5 0. T. e. 6 59. Sun r. 6 52.
m	t	w	th	f	ſ	S	22	K. GEO. II. crowned, 1727. [ſ. 5 7.
t	w	th	f	ſ	S	m	23	Sun in ♏ 31′ Noon, 1756.
w	th	f	ſ	S	m	t	24	Sun fast of Clocks 15m 45s.
th	f	ſ	S	m	t	w	25	*Crispin*, Patron of Shoe-makers.
f	ſ	S	m	t	w	th	26	
ſ	S	m	t	w	th	f	27	
S	m	t	w	th	f	ſ	28	St. SIMON and JUDE.
m	t	w	th	f	ſ	S	29	
t	w	th	f	ſ	S	m	30	
w	th	f	ſ	S	m	t	31	

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	22	30	8	15	7	16	23	1 31	8	13	10	18	25	3
2	12	19	26	4	8	5	13	19	27	14	29	7	14	22
3	30	8	15	23	9	24	2	9	17	15	17	25	3	10
4	19	27	4	12	10	13	21	28	7	16	6	14	21	29
5	8	16	23	1 31	11	1 31	19	16	24	17	25	3	11	18
6	27	5	12	20	12	20	28	6	13	18	15	23	29	7
										19	3	11	18	26

PERPETUAL TIME-TABLES:

Or General RULES for CHRONOLOGISTS, HISTORIANS, &c.

NOVEMBER xxx Days.

G	F	E	D	C	B	A	Days	*Fixed* Feasts, *Remarkable Days*, &c. *according to New Stile.*
th	f	ſ	S	m	t	w	1	ALL SAINTS. D. br. 5 18. T. e. 6 41.
f	ſ	S	m	t	w	th	2	ALL SOULS. Sun r. 7 13. ſ. 4 47.
ſ	S	m	t	w	th	f	3	All Souls College Election.
S	m	t	w	th	f	ſ	4	K. WILL. born. Sun f. of Cl. 16m 13s.
m	t	w	th	f	ſ	S	5	POWDER-PLOT, 1605, *O. S.*
t	w	th	f	ſ	S	m	6	Leonard. Michaelmas Term begins.
w	th	f	ſ	S	m	t	7	Pr. *Henry-Frederic* b. 1745.
th	f	ſ	S	m	t	w	8	
f	ſ	S	m	t	w	th	9	K. GE. b. 1683. *N. S.* Ld. Mayor's day,
ſ	S	m	t	w	th	f	10	K. GEO. II. Birth-day kept. [Lond.
S	m	t	w	th	f	ſ	11	St. *Martin*, B. & Conf.
m	t	w	th	f	ſ	S	12	D. br. 5 33. T. e. 6 27. Sun r. 7 30.
t	w	th	f	ſ	S	m	13	Britius B. [ſ. 4 29.
w	th	f	ſ	S	m	t	14	Sun fast of Clocks 15m 11s.
th	f	ſ	S	m	t	w	15	Machutus B.
f	ſ	S	m	t	w	th	16	
ſ	S	m	t	w	th	f	17	Hugh, B. Linc. Anniversary of Q.
S	m	t	w	th	f	ſ	18	[Elizabeth's Procl. 1558.
m	t	w	th	f	ſ	S	19	
t	w	th	f	ſ	S	m	20	Edmund, K. & M.
w	th	f	ſ	S	m	t	21	D. b. 5 44. T. e. 6 16. Sun r. 7 45. ſ.
th	f	ſ	S	m	t	w	22	Cecilia. Old Martinmas-day. [4 14.
f	ſ	S	m	t	w	th	23	St. Clement. Sun in ♐ 41′ on 22 D.
ſ	S	m	t	w	th	f	24	Sun fast of Cl. 12m 46s. [Noon, 1756.
S	m	t	w	th	f	ſ	25	Catherine. Pr. Will.-Henry-Fred.
m	t	w	th	f	ſ	S	26	[b. 1743.
t	w	th	f	ſ	S	m	27	
w	th	f	ſ	S	m	t	28	Michaelmas Term ends.
th	f	ſ	S	m	t	w	29	
f	ſ	S	m	t	w	th	30	St. ANDREW. Anniv. Meet. Roy. Soc.
								[Princess Dow. of Wales b. 1719.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	21	29	6	14	7	14	22	29	7	13	8	16	23	1 30
2	10	18	25	3	8	3	11	18	26	14	27	5	12	20
3	28	6	13	21	9	22	30	8	15	15	26	23	1	9
4	17	25	3	10	10	12	19	26	4	16	5	13	20	27
5	7	14	22	29	11	30	8	15	23	17	24	2	9	17
6	26	3	11	19	12	19	27	4	12	18	13	21	28	6
										19	2	9	16	23

DECEMBER xxxi Days.

G	F	E	D	C	B	A	Days	*Fixed* Feasts, *Remarkable Days*, &c. *according to New Stile.*
ſ	S	m	t	w	th	f	1	Day Break 5 44. Twilight ends 6 6.
S	m	t	w	th	f	ſ	2	Sun rises 7 57, sets 4 3.
m	t	w	th	f	ſ	S	3	
t	w	th	f	ſ	S	m	4	Barbary. Sun fast of Cl. 9m 6s.
w	th	f	ſ	S	m	t	5	
th	f	ſ	S	m	t	w	6	*Nicholas.*
f	ſ	S	m	t	w	th	7	
ſ	S	m	t	w	th	f	8	Concept. B. V. M.
S	m	t	w	th	f	ſ	9	
m	t	w	th	f	ſ	S	10	
t	w	th	f	ſ	S	m	11	Day Br. 5 59. Tw. ends 6 1.
w	th	f	ſ	S	m	t	12	Sun rises 8 5, sets 3 55.
th	f	ſ	S	m	t	w	13	*Lucy.*
f	ſ	S	m	t	w	th	14	Sun fast of Clocks 4m 34s.
ſ	S	m	t	w	th	f	15	
S	m	t	w	th	f	ſ	16	O Sapientia.
m	t	w	th	f	ſ	S	17	Oxford and Cambridge Terms end.
t	w	th	f	ſ	S	m	18	Princess *Louisa*, Q. of Denm. b. 1724.
w	th	f	ſ	S	m	t	19	
th	f	ſ	S	m	t	w	20	Sun in ♑ 10′ on 21 D. Noon, 1756.
f	ſ	S	m	t	w	th	21	St. THOMAS. Shortest Day.
ſ	S	m	t	w	th	f	22	Sun rises 8 7, sets 3 53.
S	m	t	w	th	f	ſ	23	Sun and Clocks together.
m	t	w	th	f	ſ	S	24	Sun slow of Clocks 26s.
t	w	th	f	ſ	S	m	25	CHRISTMAS-DAY. 4th Quarter-day.
w	th	f	ſ	S	m	t	26	St. STEPHEN.
th	f	ſ	S	m	t	w	27	St. JOHN the EVANGELIST.
f	ſ	S	m	t	w	th	28	HOLY INNOCENTS.
ſ	S	m	t	w	th	f	29	
S	m	t	w	th	f	ſ	30	Sun slow of Clocks 3m 23s.
m	t	w	th	f	ſ	S	31	Silvester, B. of Rome.

The NEW, FULL, and QUARTER MOONS.

Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾	Go. No.	N M ●	F Q ☽	F M ○	L Q ☾
1	20	28	6	13	7	14	21	28	6	13	8	16	23	30
2	10	17	25	3	8	3	11	18	26	14	27	5	12	20
3	28	6	13	21	9	22	29	7	15	15	15	23	30	8
4	17	25	3	10	10	11	19	26	4	16	5	12	20	27
5	6	14	21	29	11	29	7	14	22	17	23	1 30	9	16
6	25	3	11	18	12	18	26	4	11	18	13	21	28	6
										19	1 31	9	16	24

See our SOLAR EPHEMERIS further on.

RULES

RULES *for the* STARS.

RIGHT ASCENSION *and* DECLINATION *of* STARS.

To determine the right Aſcenſion of any Star from the given right Aſcenſion of any other Star.

SAY, as the Time marked by a *Clock*, going uniformly, whether regulated or not, during the Interval of a Star's Revolution, is to 360°, *ſo is* the Time marked by the ſame Clock, between the Paſſage of that and any other Star, through the Meridian, to their Difference of Right Aſcenſion.

To determine the Right Aſcenſion of any particular Star?

RULE. When the Sun is near the *Equinox*, where its Change in Declination is *ſwifteſt*, obſerve its Meridian Height or Declination ſome Day at Noon. And by the *Method of correſponding Altitudes*, or otherwiſe, obſerve the Difference in R. A. between the choſen Star and the Sun, at the ſame Inſtant of Noon. When the Sun has paſſed the following *Solſtice*, and is returned nearly to the ſame *Parallel*, obſerve, for three or four Days together, its Meridian Altitudes, and its Difference in R. A. with the ſame Star, for determining, from theſe Obſervations, when the Sun comes into the ſame Parallel, as in the firſt Obſervation, and the Difference of R. A. for the ſame *Inſtant*.

This Method gives two Inſtants when the Sun was at equal Diſtances from the ſame *Tropic*; becauſe, at equal Diſtances, on either Side a *Tropic*, the Declinations are equal, as are likewiſe the correſponding *Arcs* of the Equator.

The *Difference* of R. A. anſwering to theſe two Inſtants, will give (the *Star being fixed*) the Arc of the Equator, or Sun's Motion in R. A. in the *Interval* of theſe two Inſtants.

The *Solſtitial Colure* therefore biſects that *Arc*, the Complement of *Half* which will be the Sun's true R. A. at the firſt Obſervation.

The Sun's R. A. being thus determined, the R. A. of the *Star* is likewiſe determined by the obſerved Difference.

	Merid. Alt. ☉ at Noon. ° ′ ″			Dif. R. A. bet. ☉ & ✱ Procyon, at Noon. ° ′ ″			
EXAMPLE. 1745, *April* 4.	46	58	41	97	52	10	Eaſt
Sept. 6.	47	29	32	53	39	29	Weſt
7.	47	7	1	54	33	36	Weſt
8.	46	44	24	55	27	43	Weſt

Interpolating theſe Obſervations, it appears that if the *Sun* had been in the Meridian *Sept.* 7ᵈ 8ʰ 50ᵐ P. M. he would have had equal Altitude, with his Altitude on *April* 4th at Noon, preceeding; *viz.* . . . 46° 58′ 41″

The Difference between his R. A. and that of the Star, had been . . 54 53 39 Weſt

Therefore, from *April* 4, to *September* 7ᵈ 8ʰ 50ᵐ Evening, the Sun had run through, in R. A. . . . 152 45 49

Whence, on *April* 4ᵈ Noon, Sun's Diſtance in R. A. from the *Tropic* of ♋ was . . 76 22 54½

And had R. A. . . . 13 37 5½

The *Star* being to the *Eaſt* . . 97 52 10

The Star Procyon had R. A. *required* . . . Sum . . 111° 29′ 15″½

USES *of the* RIGHT ASCENSION *and* DECLINATION *of the* STARS.

1. *To find the Longitude and Latitude* of thoſe Stars.
2. *To ſhew the Order in diurnal Revolution, and the Intervals of Time they take in ſucceeding each other in their Paſſage through the Meridian.*
3. *To compute at what Time each Star paſſes the Meridian.* *Thus,* Take the Difference between the Star's R. A. and the R. A. of the Sun, for the Noon of the given Day, reduce this Difference to Time, by *Tab. p.* 28, which will be nearly the *Interval* of Time from Noon to Noon of the Star's Paſſage through the Meridian.

The above *Computation* gives the *Time of the Paſſage* but *nearly*; becauſe neither the Sun or Star are ſuppoſed to have any Motion in R. A.

But, *to find the correct Time,* compute the Sun and Star's R. A. for the Time *already* found, and their Difference, reduced to Time, will give the *correct* Inſtant of the Star's paſſing the Meridian.

EXAMPLE. *Suppoſe the R. A. of Mars, on a given Day at Noon be* 112° 18′, *and the R. A. of the Sun* 183° 42′, *the Difference* 71° 24′ *reduced to Time is* 4ʰ 45ᵐ 36ˢ. *Now Mars being eaſtward of the Sun, muſt paſs the Meridian about* 4ʰ 45ᵐ 36ˢ *before Noon, that is,* 7ʰ 14ᵐ 24ˢ *in the Morning.*

	°	′	″
The *R. A. of Mars for that Time is*	112	13	12
The *R. A. of the Sun for that Time is*	183	30	10
The *Difference*	71	16	58

Reduced to Time, is the Inſtant of the Paſſage of Mars through the Meridian . . . 7ʰ 14ᵐ 52ˢ required.

This *Computation* is plainly the *Reverſe* of the former, in finding the R. A. of the Stars by obſerving their Paſſages over the *Meridian*.

By the above Computation, the Times marked by a *Clock* may be proved.

For, obſerving at what *Inſtant* any *Star*, whoſe R. A. is known, paſſes the *Meridian*, that *Inſtant* being compared with the *other*, found by Computation, will ſhew whether the *Clock* agrees with true Time, or what it *differs* from it.

4. Another Uſe of the R. A. and Declination of Stars is, *To find the Diſtance of any Star from the Meridian of a Place at a given Time.* Or which is the ſame,

To find the Angle at the Pole, formed by the Meridian of a Place and the Circle of Declination paſſing through the Star.

METHOD. *Reduce the Interval of Time between Noon and the given Inſtant, into Degrees,* by Tab. p. 28, *add them to the Sun's R. A. at that Inſtant; and from the Sum ſubtract the Star's R. A.*

N. B. When the ſaid *Sum* is leſs than the Star's R. A. add to it 360°.

RULES *for* SUN *and* STARS.

FROM Two of theſe THREE THINGS, the Poles HEIGHT, SUN or STAR'S DECLINATION, and *Meridian* ALTITUDE (ſignified by P, D, M. and their *Complements* by *p*, *d*, and *m*, reſpectively) being given to find a THIRD, by *Addition* and *Subtraction*, only.

RULES *for* SUN *and* STARS.

EXAMPLE I.

The Meridian Altitude of the Sun *or a Star, and the Pole's Elevation being given, to find the* Sun *or Star's Declination?*

The elevated Pole, and Meridian Altitude, on the ſame Side of the Meridian.

Pole's Height *greater* than the Meridian Altitude.

Caſe 1. *The Sum of the Complement of the Pole's Height and Meridian Altitude will be the* Sun *or Star's Declination, ſought, of the ſame Name with that of the Pole.*

Or, $p + M = D$. *Let the Pole's Height be* 50° *N. and Meridian Altitude* 30°. Then, $40^\circ + 30^\circ = 70^\circ$, the Star's Declination N. required.

N. B. *The Difference of the Pole's Height and Meridian Altitude in this Caſe being added to the Pole's Height will give the Meridian Altitude above the Pole, as in 2d Caſe, viz.* $50^\circ - 30^\circ = 20^\circ$; $+ 50 = 70^\circ$ Altitude above the Pole.

Pole's Height *leſs* than the Meridian Altitude.

Caſe 2. *The Sum of the Complement of the Meridian Altitude and the Pole's Height* (being the Reverſe of the former Caſe) *will be the* Sun *or Star's Declination of the ſame Name with that of the Pole.*

Or, $m + P = D$. *Let the Pole's Height be* 20° *N. and Meridian Altitude* 40°. *Then* $50^\circ + 20^\circ = 70^\circ$, the Star's Declination N. required.

N. B. *The Difference of the Pole's Height and Meridian Altitude in this Caſe being ſubtracted from the Pole's Height gives the Meridian Altitude below the Pole,* as in 1ſt Caſe, *viz.* $40^\circ - 20^\circ = 20^\circ$ And $20^\circ - 20^\circ = 0^\circ$ Altitude beneath the Pole.

The elevated Pole and Meridian Altitude, on contrary Sides of the Meridian.

The Height of the Equator *greater* than the Meridian Altitude.

Caſe 3. *Subtract the Meridian Altitude from the Equator's Height, and the Remainder will be the* Sun *or Star's Declination, with a contrary Name to that of the Pole.*

Or, $p - M = D$. *Let the Pole's Height be* 70° *N. and Meridian Alt.* 15°. Then, $20^\circ - 15^\circ = 5^\circ$, the Sun or Star's Declination S. required.

The Height of the Equator *leſs* than the Meridian Altitude.

Caſe 4. *Subtract the Equator's Height from the Meridian Altitude* (being the Reverſe of the former Caſe) *and the Remainder will be the Declination of like Name with that of the Pole.*

Or, $M - p = D$. *Let the Pole's Height be* 50° *N. and Meridian Altitude* 50°. Then, $50^\circ - 40^\circ = 10^\circ$, the Sun or Star's Declination, N. required.

EXAMPLE II.

The Pole's Height and Sun *or Star's Declination being given to find the* Sun *or Star's Meridian Altitude?*

The Pole's Elevation and Star's Declination, of the ſame Name.

Caſe 1. *Add the Declination to the Equator's Height, and if the Sum be leſs than* 90°, *it will be the Meridian Altitude ſought, on the contrary Side of the Meridian to that of the elevated Pole. For by Tranſpoſition of* Caſe 4. Exam. I.

$D + p = M$. *Let the Pole's Height be* 50° *N. and Declination* $\ast$ 10° *N.* Then, $10^\circ + 40^\circ = 50^\circ$, the Meridian Altitude, S. required.

Caſe 2. *When the ſaid Sum exceeds* 90°, *its Supplement to* 180° *will be the Meridian Altitude, ſought, between the Zenith and Pole.* Or by Tranſpoſition of Caſe 2. Exam. I.

$D - P = m$. *Let the Pole's Height be* 20° *N. and Star's Declination* 70° *N.* $70^\circ - 20^\circ = 50^\circ$ Comp. Merid. Alt. and 40° Meridian Altitude N. ſought, *above the Pole.*

Alſo, 70° Equator's Height $+ 70^\circ$ $\ast$'s Declination $= 140^\circ -$

$$\frac{180}{\ }$$

Supplement, the Merid. Alt. 40° N. as before.

Caſe 3. *The Height of the Equator ſubtracted from the Declination of the* Sun *or Star will give the Meridian Altitude on the ſame Side of the Meridian with the Pole,* by Tranſpoſition of Caſe 1. Exam. I.

That is, $D - p = M$. *Let the Pole's Height be* 60° *N. and Declination* 40°. Then, $40^\circ - 30^\circ = 10^\circ$, The Meridian Altitude N. required, *below the Pole.*

Univerſally, when the Declination is of the ſame Name with the Pole. The Com. of Declination (or Diſtance from Pole) being ſubtracted (if poſſible) from the Pole's Height will give the Meridian Altitude *below the Pole*; and being added to the Pole's Altitude will give the Meridian Altitude *above the Pole* if under 90°.

When the Sum of the Comp. of Declination and Pole's Height exceed 90°, then the Supplement to 180° will be the Meridian Altitude on the *contrary* Side of the Meridian to that of the Pole.

Thus, in Caſe 1, foregoing, 80° $\ast$'s Diſtance from Pole $+ 50^\circ$ N. the Pole's Height $= 130^\circ$, whoſe Supplement is 50° S. the Meridian Altitude, *as before.*

In Caſe 2. 20° $\ast$'s Diſtance from Pole $+ 20^\circ$ Pole's Height N. $= 40^\circ$, Meridian Altitude N. *above the Pole,* as before.

In Caſe 3. 50° $\ast$'s Diſtance from Pole from 60° Pole's Height N. remains 10°, Meridian Altitude, *below the Pole,* as before.

The Pole's Elevation and Sun or Star's Declination, having different Names.

Caſe 4. *Subtract the Declination from the Height of the Equator and the Remainder will be the Meridian Altitude, of a contrary Name to that the Pole,* by Tranſpoſition of Caſe 3. Exam. I.

$p - D = M$. *Let the Pole's Height be* 70° *N. and* $\ast$*'s Declination* 5°. Then, $20^\circ - 5^\circ = 15^\circ$ Meridian Altitude S. required.

EXAMPLE III. Particularly useful in Navigation.

THE Star's *or* Sun's *Declination and Meridian Altitude being given for ſome one Place of the* **Earth**, *to find the Elevation of the Pole at that Place.*

When the Meridian Altitude is between the *Pole and Horizon,* and Declination of the ſame Name with the Pole.

Caſe 1. *Add the Complement of Declination to the Meridian Altitude, and the Sum will be the Height of the Pole.*

Or, $d + M = P$. *Let the Meridian Altitude* 30° *and Declination* 70° N. Then, $20^\circ + 30^\circ = 50^\circ$, the Height of the Pole required, or $D - M = p$, by Caſe 1. Exam. I. Or $70^\circ - 30^\circ = 40^\circ$ Comp. Pole, whence 50° Pole's Height, N. as before.

When the Meridian Altitude is *between the Pole and Zenith.*

Caſe 2. *Subtract the Comp. of Declination (or Diſtance from Pole) from the Meridian Altitude, and the Remainder will be the Pole's Height.*

Or,

RULES *for* SUN *and* STARS.

Or, $M - d = P$. *Let the Merid'an Altitude be* 40° *and* ✱*'s Declination* 70° *N.* Then, 40° — 20° = 20°, the Pole's Height N. required. Or $D - m = P$, by Tranſpoſition of Caſe 2. Exam. I. Or 70° — 50° = 20°, Pole's Height N. as before.

When the Meridian Altitude and the Pole, are on *contrary Sides of the Meridian.*

CASE 3. *Subtract the Declination from the Altitude, and the Remainder is the Height of the Equator, or Comp. of the Pole's Altitude.*

Or, $M - D = p$. *Let Meridian Altitude* 50° *and* ✱*'s Declination* 10°. Then, 50° — 10° = 40° Comp. Latitude. Whence 50° Height Pole, N. required.

For, $M - D = p$. by Tranſpoſition of Caſe 4. Exam. I.

When the Declination and Poſe are of DIFFERENT NAMES.

CASE 4. *Add the Meridian Altitude and* ✱*'s Declination, and the Sum will be the Height of the Equator, whoſe Com. is the Poles Height.*

$M + D = p$. Let the Meridian Altitude be 15° and Star's Declination 5° S.

Then, 15° + 5° = 20°, the Equator's Altitude, whence 70° Pole's Height, N. *required.*

For $M + D = p$, by Tranſpoſition of Caſe 3. Exam. I.

⁂ *The foregoing are all the Caſes that can happen from the different Data of any two of the three foregoing Arcs of great Circles of the Sphere, viz. Pole's Heights, Star's or* SUN's *Declination, and Meridian Altitude.*

The other Circumſtances of the Poſition and Phænomena of the Stars, in reſpect of the great Circles of the Sphere, for any particular Place of the Earth, are computed by the Rules of Trigonometry.

ANY THREE of theſe FIVE THINGS *being given; the Obliquity of the* ECLIPTIC, a Star's Right ASCENSION, DECLINATION, LONGITUDE, LATITUDE, the other Two *may be determined.*

Theſe are practically reduced to the Obliquity of the Ecliptic, the Meaſure of Time, and right Aſcenſion and Declination of each Star; from whence the Longitude and Latitude of a Star are eaſily known.

TABLE of the *Apparent* SEMI-DIAMETER of the SUN, TIME of his Paſſing the MERIDIAN, and his DISTANCE from the EARTH, for every 10th Day of the Leap-Year, 1756, N. S. By *Connoiſſance des Temps.*

Days	JANUARY. Sem. Diam. app. ☉	T. of ☉ paſſing Meridian.	Diſt. ☉ from ⊖	FEBRUARY. Sem. Diam. app. ☉	Time ☉ paſſing Meridian.	Diſt. ☉ from ⊖	MARCH. Sem. Diam. app. ☉	Time ☉ paſſing Meridian.	Diſt. ☉ from ⊖	APRIL. Sem. Diam. app. ☉	Time ☉ paſſing Meridian.	Diſt. ☉ from ⊖
	′ ″	M. S.	S. Ds. ⊖	′ ″	M. S.	S. Ds. ⊖	′ ″	M. S.	S. Ds. ⊖	′ ″	M. S.	S. Ds. ⊖
10	16 20	2 21	21638	16 16	2 14	21730	16 9	2 10	21886	16 0	2 9	22083
20	16 19	2 19	21659	16 14	2 11	21780	16 7	2 9	21951	15 58	2 10	22141
30	16 18	2 16	21690	16 12	2 10	21836	16 3	2 8	22016	15 56	2 12	22197
Days	MAY.			JUNE.			JULY.			AUGUST.		
10	15 54	2 14	22253	15 49	2 17	22349	15 48	2 18	22365	15 52	2 12	22285
20	15 52	2 15	22286	15 48	2 18	22365	15 49	2 16	22349	15 54	2 11	22252
30	15 50	2 16	22320	15 48	2 18	22370	15 50	2 14	22321	15 56	2 10	22195
Days	SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
10	15 59	2 9	22137	16 7	2 10	21949	16 14	2 17	21767	16 19	2 22	21652
20	16 1	2 9	22076	16 9	2 12	21885	16 16	2 19	21718	16 20	2 22	21635
30	16 3	2 9	22014	16 12	2 14	21829	16 18	2 21	21685	16 20	2 22	21630

EQUATION of the SUN's PLACE, for every 4 *Julian* YEARS. According to *Halley*'s Motions.

Days.	January.	February.	March.	April.	May.	June.	July.	Auguſt.	Septemb.	October.	November.	December.
	+	+	+	+	+	+	+	+	+	+	+	+
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1	1 44	1 46	1 47	1 49	1 51	1 52	1 53	1 52	1 51	1 49	1 47	1 45
11	1 45	1 46	1 48	1 50	1 52	1 53	1 53	1 52	1 50	1 48	1 46	1 45
21	1 45	1 47	1 48	1 51	1 52	1 53	1 53	1 51	1 50	1 48	1 46	1 44

EQUATION of the SUN's PLACE for every 4 *Julian* YEARS. According to *De la Caille.*

Days.	January.	February	March.	April.	May.	June.	July.	Auguſt.	Septemb.	October.	November.	December.
	+	+	+	+	+	+	+	+	+	+	+	+
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1	1 44	1 47	1 47	1 48	1 48	1 51	1 52	1 52	1 47	1 45	1 44	1 46
11	1 45	1 47	1 47	1 47	1 50	1 52	1 50	1 53	1 45	1 46	1 45	1 47
21	1 46	1 47	1 50	1 48	1 50	1 52	1 51	1 49	1 45	1 44	1 47	1 45

A Solar EPHEMERIS, commencing 1756, and serving by Means of EQUATIONS to the END of the present CENTURY.

A TABLE of the TIME of the DAY by a *regulated* CLOCK when it is NOON by the SUN. Shewing the EQUATION of natural DAYS, and Advance and Retreat of CLOCK-TIME for the LEAP-YEAR.

Days	JAN. ☉ sl. Cl. h. m. s.	Dif. s	Cl. Eq. + m s	FEB. ☉ sl. Cl. h m s	Dif. s	Cl. Eq. + m s	MARCH ☉ sl. Cl. h m s	Dif. s	Cl. Eq. + m s	APRIL. ☉ sl. Cl. h m s	Dif. s	Cl. Eq. + m s	MAY. ☉ f. Cl. h m s	Dif. s	Cl. Eq. + m s	JUNE. ☉ f. Cl. h m s	Dif. s	Cl. Eq. + m s
		ad			ad			re.			ic			re			ad	
1	12 4 28	28	20 37	12 14 12	7	30 21	12 12 36	13	28 45	12 3 48	18	19 57	11 56 47	7	12 56	11 57 20	9	13 29
2	12 4 56	27	21 5	12 14 19	6	30 28	12 12 23	13	28 32	12 3 30	19	19 39	11 56 40	7	12 49	11 57 29	10	13 38
3	12 5 23	27	21 22	12 14 25	5	30 34	12 12 10	14	28 19	12 3 11	18	19 20	11 56 33	6	12 42	11 57 39	10	13 48
4	12 5 50	27	21 59	12 14 30	4	30 39	12 11 56	14	28 5	12 1 53	18	19 2	11 56 27	6	12 36	11 57 49	10	13 58
5	12 6 17	26	22 26	12 14 34	4	30 43	12 11 42	15	27 51	12 2 35	18	18 44	11 56 21	5	12 30	11 57 59	10	14 8
6	12 6 43	26	22 52	12 14 38	2	30 47	12 11 28	15	27 37	12 2 17	17	18 26	11 56 16	4	12 25	11 58 9	11	14 18
7	12 7 9	25	23 18	12 14 40	2	30 49	12 11 13	15	27 22	12 2 0	17	18 9	11 56 12	4	12 21	11 58 20	11	14 29
8	12 7 34	25	23 43	12 14 42	1	30 51	12 10 58	16	27 7	12 1 43	17	17 52	11 56 8	4	12 17	11 58 31	11	14 40
9	12 7 59	24	24 8	12 14 43	1	30 52	12 10 42	16	26 51	12 1 26	17	17 35	11 56 4	3	12 13	11 58 42	12	14 51
10	12 8 23	23	24 32	12 14 44	1	30 53	12 10 26	16	26 35	12 1 9	16	17 18	11 56 1	2	12 10	11 58 54	12	15 3
11	12 8 46	23	24 55	12 14 43	*1	30 52	12 10 10	17	26 19	12 0 53	16	17 2	11 55 59	1	12 8	11 59 6	12	15 15
12	12 9 9	22	25 18	12 14 42	2	30 51	12 9 53	17	26 2	12 0 37	16	16 46	11 55 58	1	12 7	11 59 18	12	15 27
13	12 9 31	22	25 40	12 14 40	3	30 49	12 9 36	17	25 45	12 0 21	15	16 30	11 55 57	ad	12 6	11 59 30	12	15 39
14	12 9 53	22	26 2	12 14 37	4	30 46	12 9 19	17	25 28	12 0 6	15	16 15	11 55 56	1	12 5	11 59 42	13	15 51
15	12 10 14	20	26 23	12 14 33	4	30 42	12 9 2	18	25 11	11* 59 51	15	16 0	11 55 56	1	12 5	11 59 55	13	16 4
16	12 10 34	19	26 43	12 14 29	5	30 38	12 8 44	18	24 53	11 59 36	15	15 45	11 55 57	2	12 6	12* 0 8	13	16 17
17	12 10 53	19	27 2	12 14 24	5	30 33	12 8 26	18	24 35	11 59 21	14	15 30	11 55 58	2	12 7	12 0 21	13	16 30
18	12 11 12	18	27 21	12 14 19	6	30 28	12 8 8	18	24 17	11 59 7	13	15 16	11 56 0	3	12 9	12 0 34	13	16 43
19	12 11 30	17	27 39	12 14 19	7	30 22	12 7 50	18	23 59	11 58 54	13	15 3	11 56 2	4	12 11	12 0 47	13	16 56
20	12 11 47	17	27 56	12 14 6	8	30 15	12 7 32	18	23 41	11 58 41	13	14 50	11 56 5	4	12 14	12 1 0	13	17 9
21	12 12 4	16	28 13	12 13 58	8	30 7	12 7 14	19	23 23	11 58 28	12	14 37	11 56 9	4	12 18	12 1 13	13	17 22
22	12 12 20	15	28 29	12 13 50	9	29 59	12 6 55	19	23 4	11 58 16	12	14 25	11 56 13	5	12 22	12 1 26	13	17 35
23	12 12 35	14	28 44	12 13 41	9	29 50	12 6 36	19	22 45	11 58 4	12	14 13	11 56 17	6	12 26	12 1 39	13	17 48
24	12 12 49	13	28 58	12 13 32	10	29 41	12 6 17	19	22 26	11 57 52	11	14 1	11 56 22	6	12 31	12 1 52	13	18 1
25	12 13 2	13	29 11	12 13 22	11	29 31	12 5 58	18	22 7	11 57 41	10	13 50	11 56 28	7	12 37	12 2 5	12	18 14
26	12 13 15	11	29 24	12 13 11	11	29 20	12 5 40	19	21 49	11 57 31	10	13 40	11 56 34	7	12 43	12 2 17	12	18 26
27	12 13 26	11	29 35	12 13 0	12	29 9	12 5 21	19	21 30	11 57 21	9	13 30	11 56 41	7	12 50	12 2 29	12	18 38
28	12 13 37	10	29 46	12 12 48		28 57	12 5 2	18	21 11	11 57 12	9	13 21	11 56 48	8	12 57	12 2 41	12	18 50
29	12 13 47	9	29 56		* re		12 4 44	19	20 53	11 57 3	8	13 12	11 56 55	8	13 4	12 2 53	12	19 2
30	12 13 56	9	30 5				12 4 25	19	20 34	11 56 55	8	13 4	11 57 3	9	13 12	12 3 5	11	19 14
31	12 14 5		30 14				12 4 6		20 15	* fast.			11 57 11		13 20	* slow.		
	Clock-Time advances 9^m 45^s in this Month.			Cl. T. advances 0^m 33^s retreats 2^m 6^s in this Month.			Clock-Time retreats 8^m 49^s in this Month.			Clock-Time retreats 7^m 1^s in this Month.			Clock-Time retreats 0^m 50^s, advances 1^m 24^s in this Month.			Clock-Time advances 5^m 55^s in this Month.		

☞ IN taking the *Time* of the DAY, and *Clock-Time-Equation,* out of the above *Table,* you must take out for 1 Day sooner in the Months of *January,* and *February,* for Leap-Year: For other Months in that Year take out for the Days as they stand. And, for the 1st, 2d, and 3d Years after any Leap-Year, you must take out for $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{1}{4}$ of a Day *sooner,* in all the Months, *respectively.*

EXAMPLES. REQUIRED *the Times by the Clock, when it is Noon by the Sun,* January 10th, 1760, February 23, 1761, June 29th, 1762, *and* December 15th, 1763, *respectively?*

Leap-Year.	h	m	s	Com. Year.	h	m	s	Com. Year	h	m	s	Com. Year.	h	m	s
Jan. 9, 1760. . . .	12	7	59	Feb. 23. .	12	13	41	June 29. . .	12	2	53	December 15. . . .	11	55	58
For 10, 1 Day sooner				$\frac{1}{4}$ Day sooner		+	2	$\frac{1}{2}$ Day sooner		—	6	$\frac{1}{4}$ Day sooner . . .		—	22
Answers, required				1761. .	12	13	43	1762. . .	12	2	47	1763.	11	55	36

So for the Rest.

*** *Compare this short Method with* Ferguson's EQUATION-TABLES, in his ASTRONOMY *repeated for three Years after Leap-Year.*

The Days, on which the *Sun's* and *Clock's Time* meet, or when the Time by a *Sun-Dial,* and that by a regulated Clock is the same, once in 24 Hours, are observed to be on *April* 15*th,* *June* 16*th,* *August* 31*st,* and *December* 24*th,* one Year with another. *N. S.*

A Solar EPHEMERIS, commencing 1756, and serving by Means of EQUATIONS to the END of the present CENTURY.

A TABLE of the TIME of the DAY by a *regulated* CLOCK when it is NOON by the SUN. Shewing the EQUATION of natural DAYS, and Advance and Retreat of CLOCK-TIME for the LEAP-YEAR.

Days.	JULY. ☉ ſl. Cl.	Dif.	Cl. Eq. +	AUG. ☉ ſl. Cl.	Dif.	Cl. Eq. +	SEPT. ☉ f. Cl.	Dif.	Cl. Eq. +
	h m s	s	m s	h m s	s	m s	h m s	s	m s
1	12 3 16	ad	19 25	12 5 44	re	21 53	11 59 33	re	15 42
2	12 3 27	11	19 36	12 5 40	4	21 49	11 59 14	19	15 23
3	12 3 38	11	19 47	12 5 36	4	21 45	11 58 55	19	15 4
4	12 3 49	11	19 58	12 5 31	5	21 40	11 58 36	19	14 45
5	12 4 0	11	20 9	12 5 25	6	21 34	11 58 17	19	14 26
6	12 4 10	10	20 19	12 5 19	6	21 28	11 57 57	20	14 6
7	12 4 19	0	20 28	12 5 12	7	21 21	11 57 35	20	13 46
8	12 4 28	9	20 37	12 5 5	7	21 14	11 57 17	20	13 26
9	12 4 37	9	20 46	12 4 57	8	21 6	11 56 57	20	13 6
10	12 4 46	9	20 55	12 4 48	9	20 57	11 56 37	20	12 46
11	12 4 54	8	21 3	12 4 39	9	20 48	11 56 16	21	12 25
12	12 5 2	8	21 11	12 4 29	10	20 38	11 55 55	21	12 4
13	12 5 9	7	21 13	12 4 19	10	20 28	11 55 34	21	11 43
14	12 5 16	7	21 25	12 4 8	11	20 17	11 53 13	21	11 22
15	12 5 22	6	21 36	12 3 56	12	20 5	11 54 52	21	11 1
16	12 5 28	6	21 37	12 3 44	12	19 53	11 54 31	21	10 40
17	12 5 33	5	21 42	12 3 32	12	19 41	11 54 11	20	10 20
18	12 5 38	5	21 41	12 3 19	13	19 28	11 53 50	21	9 59
19	12 5 42	4	21 31	12 3 6	13	19 15	11 53 29	21	9 38
20	12 5 46	4	21 55	12 2 52	14	19 1	11 53 8	21	9 17
21	12 5 49	3	21 38	12 2 38	14	18 47	11 52 47	21	8 56
22	12 5 51	2	22 0	12 2 23	15	18 32	11 52 26	21	8 35
23	12 5 53	2	22 2	12 2 8	15	18 17	11 52 6	20	8 15
24	12 5 55	2	22 4	12 1 52	16	18 1	11 51 46	20	7 55
25	12 5 56	1	22 5	12 1 36	16	17 45	11 51 26	20	7 35
26	12 5 56	*0	22 5	12 1 19	17	17 28	11 51 6	20	7 15
27	12 5 55	1	22 4	12 1 2	17	17 11	11 50 46	20	6 55
28	12 5 54	1	22 3	12 0 45	17	16 54	11 50 26	20	6 35
29	12 5 53	2	22 2	12 3 28	17	16 37	11 50 7	19	6 16
30	12 5 51	3	22 0	12 0 10	18	16 19	11 49 48	19	5 57
31	12 5 48	4	22 57	11* 59 52	18	16 1		19	
	*re. Cl. T. adv. 2^m 40^s. re. 0^m 12^s in this Month.			* fast. Clock-Time retreats 6^m 11^s in this Month.			Clock-Time retreats 10^m 4^s in this Month.		

Days.	OCT. ☉ f. Cl.	Dif.	Cl. Eq. +	NOV. ☉ f. Cl.	Dif.	Cl. Eq. +	DEC. ☉ f. Cl.	Dif.	Cl. Eq. +
	h m s	s	m s	h m s	s	m s	h m s	s	m s
1	11 49 29	re	5 38	11 43 51	ad	0 0	11 49 43	ad	5 52
2	11 49 11	18	5 20	11 43 51	0	0 0	11 50 7	24	6 16
3	11 48 53	18	5 2	11 43 52	1	0 1	11 50 31	24	6 40
4	11 48 35	18	4 44	11 43 53	1	0 2	11 50 56	25	7 5
5	11 48 17	18	4 26	11 43 55	2	0 4	11 51 21	25	7 30
6	11 48 0	17	4 9	11 43 58	3	0 7	11 51 47	26	7 56
7	11 47 43	17	3 52	11 44 2	4	0 11	11 52 13	26	8 22
8	11 47 27	16	3 36	11 44 7	5	0 16	11 52 40	27	8 40
9	11 47 12	15	3 21	11 44 13	6	0 22	11 53 7	27	9 16
10	11 46 57	15	3 6	11 44 20	7	0 29	11 53 35	28	9 44
11	11 46 42	15	2 51	11 44 27	7	0 36	11 54 3	28	10 12
12	11 46 27	15	2 36	11 44 35	8	0 44	11 54 31	28	10 40
13	11 46 13	14	2 22	11 44 44	9	0 53	11 55 0	29	11 9
14	11 46 0	13	2 9	11 44 54	10	1 3	11 55 29	29	11 38
15	11 45 57	13	1 56	11 45 4	10	1 13	11 55 58	29	12 7
16	11 45 35	12	1 44	11 45 16	12	1 25	11 56 27	29	12 36
17	11 45 24	11	1 33	11 45 28	12	1 37	11 56 56	29	13 5
18	11 45 13	11	1 22	11 45 41	13	1 50	11 57 26	30	13 35
19	11 45 3	10	1 12	11 45 55	14	2 4	11 57 56	30	14 5
20	11 44 53	10	1 2	11 46 10	15	2 19	11 58 26	30	14 35
21	11 44 44	9	0 53	11 46 26	16	2 35	11 58 56	30	15 1
22	11 44 35	9	0 44	11 46 43	17	2 52	11 59 26	30	15 35
23	11 44 27	8	0 36	11 47 0	17	3 9	11 59 56	30	16 5
24	11 44 20	7	0 29	11 47 18	18	3 27	12* 0 26	30	16 35
25	11 44 14	6	0 23	11 47 37	19	3 46	12 0 56	30	17 5
26	11 44 9	5	0 18	11 47 56	19	4 5	12 1 26	30	17 35
27	11 44 4	5	0 13	11 47 16	20	4 25	12 1 56	30	18 5
28	11 43 59	5	0 8	11 48 37	21	4 46	12 2 25	29	18 34
29	11 43 55	4	0 4	11 48 58	21	5 7	12 2 54	29	19 3
30	11 43 53	2	0 2	11 49 20	22	5 29	12 3 23	29	19 32
31	11 43 52	1	0 1		23		12 3 52	29	20 1
	Clock-Time retreats 5^m 38^s in this Month.			Clock-Time advances 5^m 52^s in this Month.			Clock-Time advances 14^m 38^s in this *slow Month.		

N. B. The CLOCK EQUATION for each Month of the Year, shews the Advance or Retreat of the *Clock-Time*, ~~correcting~~, or beginning its *Æra*, or *Æpocha*, from *Nov.* 2d in any Year, one of the Days in the Year (the other being *Feb.* 10, *May* 15, and *July* 26, *N. S.*) when the Sun's *mean and true Motion is very nearly alike for* 24 *Hours.* And the Advance or Retreat of Clock Time, from any one Day to any other Day in the same, or following Month, is immediately determined by taking the Difference of the *Clock-Equations* for those Days, from the *above Table.*

EXAMPLE I. *To find the Retreat of Clock-Time, from* Sept. 1, *to* Oct. 1, *(a Leap-Year,) following?*

			m	s
For Sept. 1. . . .	Clock-Time Equation.	+	15	42
Oct. 1.		+	5	38
	Dif. .		10	4 *Retreat*, as at the Bottom of September required.

EXAMPLE II. *To find the Advance of Clock-Time, from 4th July, to 29th of the same Month following.*

Clock-Time	h	m	s
July 4th, $\frac{3}{4}$ D. sooner .	12	3	40
July 29th, $\frac{3}{4}$ D. sooner .	12	5	54
Dif.		2	14 advance, as by the Clock Equation.

	h	m
For 4th July $\frac{3}{4}$ D. sooner	19	49
29th Ditto $\frac{3}{4}$ D. sooner	22	3
Dif.	2	14 advance, required.

	h	m	s	
N. B. Against Nov. 2d. . . . stands	11	43	51	Clock-Time, when 12 by the Sun.
	12			
Dif.		—16	9	; With which connecting the Clock Equation, and you will have the Equation of
Suppose for Aug. 6. a Leap-Year. . .		+21	28	[Time for that natural Day.
		+5	19	Equation of Time, which *added* to 12 Hours,

Makes 12^h 5^m 19^s the same Clock-Time, as by Tab. when it is Noon by the Sun.

So for the Rest.

A Solar EPHEMERIS, commencing 1756, and serving by Means of EQUATIONS to the END of the present CENTURY.

JANUARY.

Days	☉ Place ♑. ° ' "	Dif. ' "	☉'s Dec. S. ° ' "	Dif. ' "	☉'s R. Asc. ° ' "	Dif. ' "
1	11 38 7	61 10	22 58 22	4 34	282 39 12	66 9
2	12 39 17	61 11	22 52 48	6 2	283 45 21	66 3
3	13 40 28	61 10	22 46 46	6 28	284 51 24	65 55
4	14 41 38	61 10	22 40 18	6 56	285 57 19	65 50
5	15 42 48	61 10	22 33 22	7 22	287 3 9	65 44
6	16 43 58	61 9	22 26 0	7 48	288 8 53	65 36
7	17 45 7	61 10	22 18 12	8 15	289 14 29	65 29
8	18 46 17	61 9	22 9 57	8 42	290 19 58	65 20
9	19 47 26	61 9	22 1 15	9 6	291 25 18	65 9
10	20 48 35	61 8	21 52 9	9 32	292 30 27	65 3
11	21 49 43	61 8	21 42 37	9 58	293 35 30	64 52
12	22 50 51	61 7	21 32 39	10 23	294 40 22	64 42
13	23 51 58	61 6	21 22 16	10 46	295 45 4	64 33
14	24 53 4	61 5	21 11 30	11 12	296 49 37	64 23
15	24 54 9	61 5	21 0 18	11 36	297 54 0	64 13
16	26 55 14	61 4	20 48 42	11 58	298 58 13	64 1
17	27 56 18	61 3	20 36 44	12 22	300 2 14	63 51
18	28 57 21	61 3	20 24 22	12 46	301 6 5	63 40
19	29 58 24	61 2	20 11 36	13 57	302 9 45	63 28
20	♒ 59 26	61 1	19 58 29	13 32	303 13 13	63 15
21	2 0 27	61 0	19 44 57	13 52	304 16 28	63 4
22	3 1 27	60 59	19 31 5	14 15	305 19 32	62 52
23	4 2 26	60 58	19 16 50	14 35	306 22 24	62 41
24	5 3 24	60 58	19 2 15	14 59	307 25 5	62 30
25	6 4 22	60 57	18 47 16	15 13	308 27 35	62 16
26	7 5 19	60 56	18 32 3	15 37	309 29 51	62 4
27	8 6 15	60 5[illegible]	18 16 26	15 58	310 31 55	61 52
28	9 7 10	60 5[illegible]	18 0 28	16 16	311 33 47	61 40
29	10 8 5	60 53	17 44 12	16 33	312 35 27	61 28
30	11 8 58	60 52	17 27 39	16 53	313 36 55	61 14
31	12 9 50		17 10 46		314 38 9	

FEBRUARY.

Days	☉'s Pl ♒. ° ' "	Dif. ' "	☉'s Dec. S. ° ' "	Dif. ' "	☉'s R. Asc. ° ' "	Dif. ' "
1	13 10 41	60 49	16 53 35	17 29	315 39 11	60 49
2	14 11 30	60 48	16 36 6	17 45	316 40 0	60 37
3	15 12 18	60 46	16 18 21	18 3	317 40 37	60 25
4	16 13 4	60 44	16 0 18	18 19	318 41 2	60 13
5	17 13 48	60 43	15 41 59	18 36	319 41 15	60 1
6	18 14 31	60 42	15 23 23	18 51	320 41 16	59 49
7	19 15 13	60 41	15 4 32	19 6	321 41 5	59 36
8	20 15 54	60 40	14 45 26	19 21	322 40 41	59 24
9	21 16 34	60 38	14 26 5	19 35	323 40 5	59 13
10	22 17 12	60 37	14 6 30	19 49	324 39 18	59 2
11	23 17 49	60 35	13 46 41	20 2	325 38 20	58 47
12	24 18 24	60 33	13 26 39	20 16	326 37 7	58 37
13	25 18 57	60 32	13 6 23	20 29	327 35 44	58 26
14	26 19 29	60 30	12 45 54	20 41	328 34 10	58 18
15	27 19 59	60 29	12 25 13	20 52	329 32 28	58 4
16	28 20 28	60 27	12 4 21	21 4	330 30 32	57 55
17	29 20 55	60 25	11 43 17	21 15	331 28 27	57 44
18	♓ 21 20	60 23	11 22 2	21 25	332 26 11	57 34
19	1 21 43	60 22	11 0 37	21 37	333 23 45	57 23
20	2 22 5	60 20	10 39 0	21 45	334 21 8	57 13
21	3 22 25	60 18	10 17 15	21 55	335 18 21	57 5
22	4 22 43	60 17	9 55 20	22 4	336 15 26	56 55
23	5 23 0	60 15	9 33 16	22 13	337 12 21	56 40
24	6 23 15	60 13	9 11 3	22 21	338 9 7	56 37
25	7 23 28	60 12	8 48 42	22 28	339 5 44	56 28
26	8 23 40	60 10	8 20 14	22 35	340 2 12	56 21
27	9 23 50	60 8	8 3 39	22 34	340 58 33	56 13
28	10 23 58		7 40 45		341 54 46	

☞ In *Leap-Year*, take out for a *Day sooner*, for *Jan.* and *Feb.* only. —

				✕rs.	Lo. Log.
For 1	Years after	5^h 43 55	respectively	,2423	6158
2	Lp-Yr. take	11 37 50	for all	,4846	3145
3	out for	17 26 45	Months.	,7269	1385
		sooner.		for Dif.	for Dif.

MARCH.

Days	♓ ° ' "	Dif. ' "	☉'s Dec. ° ' "	Dif. ' "	☉'s R. Asc. ° ' "	Dif. ' "
1	11 24 4	60 5	7 18 6	22 46	342 50 50	55 57
2	12 24 9	60 2	6 55 20	23 13	343 46 47	55 49
3	13 24 11	60 0	6 32 7	23 5	344 42 36	55 44
4	14 24 11	59 59	6 9 2	23 13	345 38 20	55 36
5	15 24 10	59 56	5 45 49	23 19	346 33 56	55 31
6	16 24 6	59 54	5 22 30	23 17	347 29 27	55 23
7	17 24 0	59 52	4 59 13	23 25	348 24 50	55 18
8	18 23 52	59 50	4 35 48	23 29	349 20 8	55 14
9	19 23 42	59 48	4 12 19	23 31	350 15 22	55 8
10	20 23 30	59 46	3 48 43	23 33	351 10 30	55 1
11	21 23 16	59 45	3 25 15	23 37	352 5 31	54 57
12	22 23 1	59 43	3 1 38	23 38	353 0 28	54 54
13	23 22 44	59 41	2 38 0	23 39	353 55 22	54 48
14	24 22 25	59 38	2 14 21	23 42	354 50 10	54 48
15	25 22 3	59 36	1 50 39	23 42	355 44 58	54 43
16	26 21 39	59 34	1 26 57	23 43	356 39 41	54 41
17	27 21 13	59 33	1 3 14	23 41	357 34 22	54 37
18	28 20 46	59 30	0 39 33	23 42	358 28 59	54 34
19	29 20 16	59 28	0 15 51	23 43	359 23 33	54 33
20	♈ 19 44	59 26	N 7 52	23 41	0 18 6	54 30
21	1 19 10	59 24	0 31 33	23 39	1 12 36	54 28
22	2 18 34	59 22	0 55 12	23 37	2 7 4	54 28
23	3 17 56	59 20	1 18 49	23 36	3 1 32	54 28
24	4 17 16	59 18	1 42 25	23 34	3 56 0	54 27
25	5 16 34	59 15	2 5 59	23 32	4 50 27	54 27
26	6 15 49	59 14	2 29 31	23 28	5 54 54	54 27
27	7 15 3	59 12	2 52 59	23 23	6 39 21	54 27
28	8 14 15	59 9	3 16 22	23 21	7 33 48	54 28
29	9 13 24	59 7	3 39 43	23 16	8 28 16	54 28
30	10 12 31	59 5	4 2 59	23 12	9 22 44	54 30
31	11 11 36		4 26 11		10 17 14	

APRIL.

Days	♈ ° ' "	Dif. ' "	☉'s Dec. ° ' "	Dif. ' "	☉'s R. Asc. ° ' "	Dif. ' "
1	12 10 40	59 2	N 4 49 19	23 2	11 11 45	54 32
2	13 9 42	59 0	5 12 21	22 55	12 6 17	54 35
3	14 8 42	58 58	5 35 16	22 53	13 0 52	54 35
4	15 7 40	58 55	5 58 9	22 45	13 55 31	54 40
5	16 6 35	58 52	6 20 54	22 38	14 50 11	54 43
6	17 5 27	58 51	6 43 32	22 30	15 44 54	54 46
7	18 4 18	58 49	7 6 2	22 24	16 39 40	54 51
8	19 3 7	58 47	7 28 26	22 17	17 34 31	54 54
9	20 1 54	58 45	7 50 43	22 9	18 29 25	54 52
10	21 0 39	58 42	8 12 52	21 59	19 24 21	55 1
11	21 59 21	58 41	8 34 51	21 52	20 19 22	55 6
12	22 58 2	58 39	8 56 43	21 43	21 14 28	55 11
13	23 56 41	58 37	9 18 26	21 34	22 9 39	55 16
14	24 55 18	58 36	9 40 0	21 24	23 4 55	55 21
15	25 53 54	58 33	10 1 24	21 14	24 0 16	55 27
16	26 52 27	58 32	10 22 38	21 4	24 55 43	55 32
17	27 50 59	58 30	10 43 42	20 53	25 51 15	55 36
18	28 49 29	58 28	11 4 35	20 44	26 46 51	55 47
19	29 47 57	58 25	11 25 19	20 30	27 42 38	55 52
20	♉ 46 22	58 20	11 45 49	20 21	28 38 30	55 57
21	1 44 45	58 22	12 6 10	20 8	29 34 27	56 2
22	2 43 7	58 20	12 26 18	19 55	30 30 29	56 11
23	3 41 27	58 18	12 46 13	19 43	31 16 40	56 18
24	4 39 45	58 16	13 5 56	19 30	32 22 58	56 27
25	5 38 1	58 14	13 25 26	19 18	33 19 45	56 31
26	6 36 15	58 13	13 44 44	19 4	34 15 56	56 41
27	7 34 28	58 11	14 3 48	18 49	35 12 37	56 47
28	8 32 39	58 9	14 22 37	18 35	36 9 2[illegible]	56 54
29	9 30 48	58 8	14 41 12	18 23	37 6 18	57 2
30	10 28 56		14 59 35		38 3 10	

N. B. The Difs. for a Day preceding any Month-day of Leap-year being ✕d by ,2423 ; ,4846 ; ,7269, will give the Quantity to be subtracted from or added to the Leap-year Quantity, for That to the same Month-day, 1, 2, 3 Yrs. after Leap-year, respectively. Or 6158, 3145, 1385, being respectively added to the Lo. Logs. of Diffs. for a Day preceding the Month-day of Leap-year will give the Lo. Log. of a Quantity to be subd. fr. or added to the Leap-year Quantity for the Quant. for the same Month-day 1, 2, 3 Years after Leap-year, respectively.

See *Examples farther on, and Equations for 4 Years forward of the Quantities, or Places, for any given Year.*

A Solar EPHEMERIS, commencing 1756, and serving by Means of EQUATIONS to the END of the present CENTURY.

MAY.

Days	☉'s Pl. ♉. ° ′ ″	Dif. ′ ″	☉'s Dec. N. ° ′ ″	Dif. ′ ″	☉'s R. Asc. ° ′ ″	Dif. ′ ″
1	11 27 2	58 4	15 17 42	17 51	39 0 33	57 19
2	12 25 6	58 2	15 35 33	17 35	39 57 52	57 28
3	13 23 8	58 1	15 53 8	17 20	40 55 20	57 35
4	14 21 9	57 59	16 10 28	17 5	41 52 55	57 44
5	15 19 8	57 58	16 27 33	16 48	42 50 39	57 53
6	16 17 6	57 56	16 44 21	16 31	43 48 32	58 3
7	17 15 2	57 55	17 0 52	16 16	44 46 35	58 10
8	18 12 57	57 53	17 17 8	15 57	45 44 45	58 18
9	19 10 50	57 51	17 33 5	15 40	46 43 3	58 29
10	20 8 41	57 49	17 48 45	15 21	47 41 32	58 35
11	21 6 30	57 48	18 4 6	15 4	48 40 7	58 45
12	22 4 18	57 47	18 19 10	14 45	49 38 52	58 53
13	23 2 5	57 46	18 33 55	14 28	50 37 45	59 2
14	23 59 51	57 45	18 48 23	14 37	51 36 47	59 10
15	24 57 36	57 43	19 23 0	13 51	52 35 57	59 21
16	25 55 19	57 42	19 16 21	13 27	53 35 18	59 26
17	26 53 1	57 41	19 29 48	13 9	54 34 44	59 37
18	27 50 42	57 39	19 42 57	12 50	55 34 21	59 44
19	28 48 21	57 37	19 55 47	12 29	56 34 5	59 54
20	29 45 58	57 35	20 8 16	12 8	57 33 59	60 1
21	♊ 43 33	57 34	20 20 24	11 48	58 34 0	60 10
22	1 41 7	57 33	20 32 12	11 27	59 34 10	60 17
23	2 38 40	57 33	20 43 39	11 5	60 34 27	60 23
24	3 36 13	57 32	20 54 44	10 44	61 34 50	60 32
25	4 33 45	57 30	21 5 28	10 22	62 35 22	60 41
26	5 31 15	57 29	21 15 50	10 1	63 36 3	60 48
27	6 28 44	57 28	21 25 51	9 37	64 36 51	60 53
28	7 26 12	57 28	21 35 28	9 16	65 37 44	61 0
29	8 23 40	57 27	21 44 44	8 53	68 38 44	61 7
30	9 21 7	57 25	21 53 37	8 31	67 39 51	61 14
31	10 18 32		22 2 8		68 41 5	

JUNE.

Days	☉'s Pl. ♊. ° ′ ″	Dif. ′ ″	☉'s Dec. N. ° ′ ″	Dif. ′ ″	☉'s R. Asc. ° ′ ″	Dif. ′ ″
1	11 15 56	57 23	22 10 15	8 45	69 42 25	61 26
2	12 13 19	57 23	22 18 0	7 21	70 43 51	61 32
3	13 10 42	57 22	22 25 21	6 58	71 45 23	61 38
4	14 8 4	57 22	22 32 19	6 34	72 47 1	61 42
5	15 5 26	57 20	22 38 53	6 12	73 48 43	61 48
6	16 2 46	57 20	22 45 5	5 45	74 50 31	61 54
7	17 0 6	57 19	22 50 50	5 22	75 52 25	61 55
8	17 57 25	57 18	22 56 12	4 58	76 54 20	62 1
9	18 54 43	57 17	23 1 10	4 31	77 56 21	62 4
10	19 52 0	57 16	23 5 44	4 10	78 58 25	62 6
11	20 49 16	57 16	23 9 54	3 45	80 0 31	62 10
12	21 46 32	57 15	23 13 39	3 20	81 2 41	62 12
13	22 43 47	57 15	23 16 59	2 57	82 4 53	62 16
14	23 41 2	57 15	23 19 56	2 32	83 7 9	62 17
15	24 38 17	57 14	23 22 28	2 7	84 9 26	62 19
16	25 35 31	57 14	23 24 35	1 42	85 11 45	62 18
17	26 32 45	57 14	23 26 17	1 18	86 14 3	62 21
18	27 29 59	57 13	23 27 35	0 53	87 16 24	62 23
19	28 27 12	57 12	23 28 28	0 27	88 18 47	62 23
20	29 24 24	57 11	23 28 55	0 3	89 21 10	62 22
21	♋ 21 35	57 12	23 28 58	0 22	90 23 32	62 22
22	1 18 47	57 11	23 28 36	0 46	91 25 54	62 21
23	2 15 58	57 11	23 27 50	1 11	92 28 15	62 20
24	3 13 9	57 12	23 26 39	1 37	93 30 35	62 18
25	4 10 21	57 11	23 25 2	2 0	94 32 53	62 16
26	5 7 32	57 11	23 23 2	2 25	95 35 9	62 14
27	6 4 43	57 11	23 20 37	2 51	96 37 23	62 12
28	7 1 54	57 11	23 17 46	3 15	97 39 35	62 8
29	7 59 5	57 10	23 14 31	3 38	98 41 43	62 5
30	8 56 15		23 10 53		99 43 48	

JULY.

Days	♋					
1	9 53 26	57 11	23 6 50	4 25	100 45 49	61 57
2	10 50 37	57 11	23 2 25	4 54	101 47 46	61 55
3	11 47 48	57 12	22 57 31	5 16	102 49 41	61 49
4	12 45 0	57 11	22 52 15	5 39	103 51 30	61 44
5	13 42 11	57 11	22 46 36	6 3	104 53 14	61 39
6	14 39 22	57 11	22 40 33	6 27	105 54 53	61 34
7	15 36 33	57 12	22 34 6	6 50	106 56 27	61 27
8	16 33 45	57 12	22 27 16	7 4	107 57 54	61 23
9	17 30 57	57 11	22 20 2	7 36	108 59 17	61 16
10	18 28 8	57 13	22 12 26	7 59	110 0 33	61 9
11	19 25 21	57 13	22 4 27	8 22	111 1 42	61 2
12	20 22 34	57 14	21 56 5	8 45	112 2 44	60 56
13	21 19 48	57 14	21 47 20	9 7	113 3 40	60 49
14	22 17 2	57 15	21 38 13	9 30	114 4 29	60 42
15	23 14 17	57 15	21 28 43	9 51	115 5 11	60 36
16	24 11 32	57 16	21 18 52	10 13	116 5 47	60 27
17	25 8 48	57 15	21 8 39	10 35	117 6 14	60 19
18	26 6 3	57 16	20 58 4	10 55	118 6 33	60 11
19	27 3 19	57 16	20 47 9	11 17	119 6 44	60 3
20	28 0 35	57 [illegible]	20 35 52	11 47	120 6 47	59 53
21	28 57 53	57 10	20 24 15	11 59	121 6 40	59 45
22	29 55 12	57 19	20 12 16	12 16	122 6 25	59 36
23	♌ 52 31	57 20	20 0 0	12 40	123 6 1	59 27
24	1 49 51	57 20	19 47 20	12 59	124 5 28	59 19
25	2 47 11	57 22	19 34 21	13 16	125 4 47	59 12
26	3 44 33	57 23	19 21 5	13 38	126 3 59	59 3
27	4 41 56	57 24	19 7 27	13 57	127 3 2	58 52
28	5 39 20	57 24	18 53 30	14 14	128 1 54	58 43
29	6 36 44	57 25	18 39 16	14 33	129 0 37	58 34
30	7 34 9	57 26	18 24 43	14 52	129 59 11	58 25
31	8 31 35		18 9 51		130 57 36	

AUGUST.

Days	♌					
1	9 29 2	57 28	17 54 44	15 29	131 55 55	58 8
2	10 26 30	57 29	17 39 15	15 44	132 54 3	57 59
3	11 23 59	57 30	17 23 31	16 1	133 52 2	57 49
4	12 21 29	57 31	17 7 30	16 18	134 49 51	57 41
5	13 19 0	57 33	16 51 12	16 34	135 47 32	57 32
6	14 16 33	57 33	16 34 38	16 50	136 45 4	57 23
7	15 14 6	57 35	16 17 48	17 4	137 42 27	57 15
8	16 11 41	57 36	16 0 44	17 23	138 39 42	57 7
9	17 9 17	57 37	15 43 21	17 34	139 36 49	56 57
10	18 6 54	57 38	15 25 47	17 55	140 33 46	56 49
11	19 4 32	57 40	15 7 52	18 7	141 30 35	56 41
12	20 2 12	57 41	14 49 45	18 19	142 27 16	56 33
13	20 59 53	57 43	14 31 26	18 34	143 23 49	56 25
14	21 57 36	57 44	14 12 52	18 49	144 20 14	56 15
15	22 55 20	57 45	13 54 3	19 1	145 16 29	56 7
16	23 53 5	57 47	13 35 2	19 15	146 12 36	55 59
17	24 50 52	57 48	13 15 47	19 26	147 8 35	55 53
18	25 48 40	57 49	12 56 21	19 35	148 4 28	55 47
19	26 46 29	57 51	12 36 42	19 52	149 0 15	55 38
20	27 44 20	57 52	12 16 50	20 2	140 55 53	55 31
21	28 42 12	57 54	11 56 48	20 15	150 51 24	55 25
22	29 40 6	57 55	11 36 33	20 26	151 46 49	55 18
23	♍ 38 1	57 57	11 16 7	20 36	152 42 7	55 12
24	1 35 58	57 59	10 55 31	20 46	153 37 10	55 6
25	2 33 57	57 59	10 34 45	20 58	154 32 25	55 0
26	3 31 58	58 0	10 13 47	21 7	155 27 25	54 51
27	4 30 0	58 4	9 52 40	21 15	156 22 19	54 48
28	5 28 4	58 5	9 31 25	21 25	157 17 7	54 42
29	6 26 9	58 7	9 10 0	21 30	158 11 40	54 38
30	7 24 16	58 9	8 48 24	21 42	159 6 27	54 35
31	8 22 25		8 26 42		100 1 2	

A

A Solar EPHEMERIS, commencing 1756, and ſerving by Means of EQUATIONS to the END of the preſent CENTURY.

SEPTEMBER.

Days	☉'s Pl. ♍ ° ′ ″	Dif. ′ ″	☉'s Dec. N. ° ′ ″	Dif. ′ ″	☉'s R. Aſc. ° ′ ″	Dif. ′ ″
1	9 20 36	58 12	8 4 52	21 59	160 55 34	54 22
2	10 18 48	58 14	7 42 53	22 7	161 49 56	54 21
3	11 17 2	58 16	7 20 46	22 13	162 44 17	54 17
4	12 15 18	58 18	6 58 33	22 21	163 38 34	54 13
5	13 13 36	58 17	6 36 12	22 26	164 32 47	54 11
6	14 11 55	58 21	6 13 46	22 34	165 26 58	54 8
7	15 10 16	58 23	5 51 12	22 39	166 21 6	54 5
8	16 8 39	58 25	5 28 33	22 44	167 15 11	54 3
9	17 7 4	58 28	5 5 49	22 51	168 9 14	53 59
10	18 5 32	58 29	4 42 58	22 55	169 3 13	53 59
11	19 4 1	58 30	4 20 3	22 59	169 57 12	53 57
12	20 2 31	58 32	3 57 4	23 3	170 51 9	53 55
13	21 1 3	58 34	3 34 1	23 8	171 45 4	53 53
14	21 59 37	58 37	3 10 53	23 10	172 38 57	53 54
15	22 58 14	58 39	2 47 43	23 15	173 32 51	53 54
16	23 56 53	58 41	2 24 28	23 18	174 26 45	53 55
17	24 55 34	58 43	2 1 10	23 20	175 20 40	53 54
18	25 54 17	58 45	1 37 50	23 22	176 14 34	53 55
19	26 53 2	58 47	1 14 28	23 24	177 8 29	53 56
20	27 51 49	58 48	0 51 4	23 26	178 2 25	53 58
21	28 50 37	58 50	0 27 38	23 26	178 56 23	53 58
22	29 49 27	58 52	0 4 12	23 28	179 50 21	53 59
23	♎ 48 19	58 54	S 19 16	23 28	180 44 20	54 2
24	1 47 13	58 57	0 42 44	23 28	181 38 22	54 5
25	2 46 10	58 59	1 6 12	23 28	182 32 27	54 7
26	3 45 9	59 1	1 29 40	23 27	183 26 34	54 9
27	4 44 10	59 3	1 53 7	23 27	184 20 43	54 14
28	5 43 13	59 5	2 16 34	23 25	185 14 57	54 17
29	6 42 18	59 7	2 39 59	23 24	186 9 14	54 22
30	7 41 25		3 3 23		187 3 36	

OCTOBER.

Days	☉'s Pl. ♎ ° ′ ″	Dif. ′ ″	☉'s Dec. N. ° ′ ″	Dif. ′ ″	☉'s R. Aſc. ° ′ ″	Dif. ′ ″
1	8 40 34	59 11	3 26 47	23 20	187 58 3	54 30
2	9 39 45	59 13	3 50 7	23 17	188 52 33	54 34
3	10 38 58	59 15	4 13 24	23 14	189 47 7	54 41
4	11 38 13	59 17	4 36 38	23 10	190 41 48	54 46
5	12 37 30	59 19	4 59 48	23 6	191 36 34	54 50
6	13 36 49	59 21	5 22 54	23 4	192 31 24	54 57
7	14 36 10	59 23	5 45 58	22 59	192 26 21	55 5
8	15 35 33	59 26	6 8 57	22 53	194 21 26	55 12
9	16 34 59	59 28	6 31 50	22 43	195 16 38	55 17
10	17 34 27	59 31	6 54 33	22 47	196 11 55	55 25
11	18 33 58	59 32	7 17 20	22 37	197 7 20	55 33
12	19 33 30	59 34	7 39 57	22 32	198 2 53	55 39
13	20 33 4	59 36	8 2 29	22 23	198 58 32	55 49
14	21 32 40	59 38	8 24 52	22 16	199 54 21	55 57
15	22 32 18	59 39	8 47 8	22 9	200 50 18	56 5
16	23 31 57	59 41	9 9 17	22 2	201 46 23	56 14
17	24 31 38	59 44	9 31 19	21 52	202 42 37	56 23
18	25 31 22	59 46	9 53 11	21 45	203 39 0	56 33
19	26 31 8	59 49	10 14 56	21 35	204 35 33	56 42
20	27 30 57	59 50	10 36 31	21 25	205 32 15	56 53
21	28 30 47	59 52	10 57 56	21 16	206 29 8	57 1
22	29 30 39	59 54	11 19 12	21 5	207 26 9	57 12
23	♏ 30 33	59 56	11 40 17	20 55	208 23 21	57 23
24	1 30 29	59 57	12 1 12	20 43	209 20 44	57 34
25	2 30 26	59 59	12 21 55	20 33	210 18 18	57 46
26	3 30 25	60 2	12 42 28	20 20	211 16 4	57 56
27	4 30 27	60 4	13 2 48	20 8	212 14 0	58 7
28	5 30 31	60 5	13 22 56	19 56	213 12 7	58 19
29	6 30 36	60 7	13 42 52	19 42	214 10 26	58 30
30	7 30 43	60 9	14 2 34	19 29	215 8 56	58 42
31	8 30 52		14 22 3		216 7 38	

NOVEMBER.

Days	♏					
1	9 31 3	60 13	14 41 18	18 51	217 6 32	59 7
2	10 31 16	60 15	15 0 19	18 45	218 5 39	59 19
3	11 31 31	60 16	15 19 4	18 31	219 4 58	59 30
4	12 31 47	60 18	15 37 35	18 15	220 4 28	59 44
5	13 32 5	60 20	15 55 50	17 59	221 4 12	59 57
6	14 32 25	90 21	16 13 49	17 43	222 4 9	60 9
7	15 32 46	60 23	16 31 32	17 26	223 4 18	60 21
8	16 33 9	60 25	16 48 58	17 9	224 4 39	60 44
9	17 33 34	60 25	17 6 7	16 52	225 5 13	60 47
10	18 34 1	60 28	17 22 59	16 32	226 6 0	60 59
11	19 34 29	60 30	17 39 31	16 15	227 6 59	61 10
12	20 34 59	60 31	17 55 46	15 56	228 8 9	61 25
13	21 55 30	60 33	18 11 42	15 37	229 9 34	61 38
14	22 36 3	60 34	18 27 19	15 18	230 11 12	61 50
15	23 36 37	60 36	18 42 37	14 59	231 13 2	62 3
16	24 37 13	60 38	18 57 36	14 35	232 15 5	62 14
17	25 37 51	60 39	19 12 11	14 16	233 17 19	62 29
18	26 38 30	60 41	19 26 27	13 55	234 19 48	62 41
19	27 39 11	60 42	19 40 22	13 34	235 22 29	62 52
20	28 39 53	60 43	19 53 56	13 31	236 25 21	63 5
21	29 40 36	60 45	20 7 7	12 50	237 28 26	63 17
22	♐ 41 21	60 46	20 19 57	12 27	238 31 43	63 28
23	1 42 7	60 47	20 32 24	12 4	239 35 11	63 39
24	2 42 54	60 48	20 44 28	11 41	240 38 50	63 51
25	3 43 42	60 50	20 56 9	11 17	241 42 41	64 2
26	4 44 32	60 51	21 7 26	10 53	242 46 43	64 13
27	4 45 23	60 52	21 18 19	10 29	243 50 56	64 25
28	6 46 15	60 54	21 28 48	10 5	244 55 21	64 33
29	7 47 9	60 55	21 38 53	9 40	245 59 54	64 44
30	8 48 4		21 48 33		247 4 38	

DECEMBER.

Days	♐					
1	9 49 0	60 57	21 57 48	8 50	248 9 33	65 6
2	10 49 57	60 58	22 6 38	8 23	249 14 39	65 13
3	11 50 55	60 58	22 15 1	7 57	250 19 52	65 22
4	12 51 53	60 59	22 22 58	7 32	251 25 14	65 29
5	13 52 52	61 0	22 30 30	7 5	252 30 43	65 34
6	14 53 52	61 1	22 37 35	6 38	253 36 17	65 43
7	15 54 53	61 2	22 44 13	6 11	254 42 0	65 51
8	16 55 55	61 3	22 50 24	5 45	255 47 51	65 58
9	17 56 58	61 3	22 56 9	5 18	256 53 49	66 5
10	18 58 1	61 4	23 1 27	4 49	257 59 54	66 12
11	19 59 5	61 5	23 6 16	4 23	259 6 6	66 14
12	21 0 10	61 6	23 10 39	3 54	260 12 20	66 20
13	22 1 16	61 6	23 14 33	3 27	261 18 40	66 25
14	23 2 22	61 7	23 18 0	2 57	262 25 5	66 28
15	24 3 29	61 7	23 20 57	2 32	263 31 33	66 31
16	25 4 36	61 8	23 23 29	2 3	264 38 4	66 35
17	26 5 44	61 8	23 25 32	1 35	265 44 39	66 36
18	27 6 52	61 9	23 27 7	1 6	266 51 15	66 39
19	28 8 1	61 9	23 28 13	0 37	267 57 54	66 41
20	29 9 10	61 10	23 28 50	0 10	269 4 35	66 41
21	♑ 10 20	61 9	23 29 0	0 20	270 11 16	66 41
22	1 11 29	61 10	23 28 40	0 47	271 17 57	66 41
23	2 12 39	61 10	23 27 53	1 16	272 24 38	66 40
24	3 13 49	61 10	23 26 37	1 43	273 31 18	66 38
25	4 14 59	61 10	23 24 [illegible]	2 12	274 37 56	66 36
26	5 16 9	61 11	23 22 42	2 41	275 44 32	66 34
27	6 17 20	61 11	23 20 1	3 49	276 51 6	66 32
28	7 18 31	61 11	23 16 52	3 36	277 57 38	66 28
29	8 19 42	61 11	23 13 16	4 4	279 4 6	66 25
30	9 20 53	61 11	23 9 12	4 33	280 10 31	66 30
31	10 22 4		23 4 30		281 16 51	

I. CATALOGUE of remarkable FIXED STARS, their *Longitudes* and *Latitudes*, for the Beginning of the Year 1720, *O. S.* according to HALLEY. For comparing with the CHANGES of their observed PLACES, in remote YEARS, and thereby to find the exact Quantity of their MOTION.

N. B. Sparkling *and* lucid *Stars are generally distinguished by* brightest *and* bright.

Names of Stars.	Mag.		Longitude. °	′	″	Latitude. °	′	″	N or S
THE									
Extreme of *Pegasus* Wing	2	♈	5	14	50	12	35	12	N
Head of *Andromeda*	2		10	23	53	25	41	1	N
Northern in the Whale's Belly	3		18	1	47	20	21	19	S
Knot of the Fishes	3		25	27	33	9	5	10	S
Brightest in Andromeda's Girdle	2		26	27	44	25	56	19	N
Southern in Horn of ♈. . * ♈	4		29	16	0	7	8	58	N
Northern in same Horn	3	♉	0	3	0	8	28	16	N
Bright * Cassiop. Chair	2		1	13	7	51	13	50	N
Bright * ♈, above the Neck	2		3	44	18	9	57	12	N
* in Cassiopea Breast, *Schedir*	2		3	55	21	46	35	54	N
Flexure of Cassiop. Hip.	[illegible]		10	3	44	48	47	35	N
Southern Foot of Andromeda	2		10	20	44	27	46	7	N
Bright * Whale's Jaw	2		10	24	15	12	37	0	S
———in the Knee of Cassiop.	3		14	2	15	46	23	26	N
Head of *Medusa.* Algol	2		22	15	42	22	23	47	N
Brightest of *Pleiades*	3		26	5	8	4	0	37	N
Brightest in the Side of *Perseus*	2		28	11	4	30	5	20	N
First of *Hyades*, in Bull's Nose	3	♊	1	52	34	5	46	22	S
Northern Eye of the Bull	3		4	32	11	2	35	58	S
Bull's Southern Eye, *Aldebaran*	1		5	52	0	5	29	50	S
Bright * Orion's Foot, *Rigel*	1		12	55	0	31	11	11	S
Orion's Right Shoulder	2		17	2	33	16	51	[illegible]	S
Goat, *Hircus*	1		17	56	41	22	51	47	N
Preceding of brightest in the Dove	2		18	16	38	57	24	15	[illegible]
First of Orion's Girdle	2		18	26	38	23	36	7	S
Northern Horn of the Bull	2		18	38	56	5	21	34	N
Middle * in Orion's Girdle	2		19	32	44	24	[illegible]	23	S
Following in the same Girdle	2		20	46	45	25	20	17	S
Tip of Bull's Southern Horn	3		20	52	55	2	14	24	S
Following the brightest in the Dove	2		22	31	5	59	15	8	S
Last of the Tail of little Bear, *Polar*	2		24	39	41	66	4	11	N
Following Shoulder Orion	1		24	50	0	16	4	26	S
Following Shoulder *Auriga*, or Driver	2		26	0	32	21	28	20	N
Fore Foot of preceding Twin	3		29	31	43	0	56	0	S
Following in same Foot, *Calx*	3	♋	1	23	10	0	51	[illegible]	S
Extremity G. Dog's Fore Foot	2		3	17	58	41	17	47	S
Foot of the following Twin	2		5	11	18	6	47	19	S
Great Dog's Mouth, *Syrius*	1		10	14	0	39	32	8	S
Knee of following Twin	3		11	4	40	2	5	27	S
Rudder of Ship Argus, *Canopus*	1		11	9	0	75	51	0	S
Groin of the following Twin	3		14	30	20	0	13	7	S
Head of preceding Twin, *Castor*	2		16	20	20	10	3	48	N
* between Thighs Gr. Dog	2		16	55	0	51	22	48	S
Head of following Twin. *Pollux*	2		19	21	9	6	39	27	N
* in G. Dog's Belly	2		19	32	5	48	27	33	S
Little Dog, *Procyon*	1		21	55	21	15	57	55	S
Tail of Gr. Dog	2		25	40	27	50	37	41	S
Northern Ass	4	♌	3	38	0	3	9	41	N
Southern Ass	4		4	48	40	0	3	46	N
Northern of preceding in □ Gr. Bear	2		11	15	0	49	40	5	N
Brightest in Deck of Ship *Argus*	2		14	41	24	58	21	6	S
Northern of preceding in □ Gr. Bear	2		15	29	12	45	6	16	N
The Lyon's Head, more Southern	3		16	47	16	9	41	4	N
Hydra's Heart	2		23	23	0	22	24	32	S
* under Ship's Deck	2		23	26	0	14	27	32	S
Northern of 3, in Lyon's Neck	3		23	38	41	11	50	13	N
Southern in the same Neck	3		23	59	24	4	50	20	N
Middle and bright * in same Neck	2		25	40	5	8	47	27	N
Lyon's Heart, *Regulus*	1		25	56	20	0	26	38	N
Lower of the following in □ Gr. Bear	2		26	31	35	47	7	26	N

Names of Stars.	Mag.		Longitude. °	′	″	Latitude. °	′	″	N or S
THE									
Northern among the same	3	♌	27	5	40	51	39	36	N
Last but 2 in Dragon's Tail	3	♍	3	28	11	66	21	43	N
Beginning Gr. Bear's Tail	2		4	56	25	54	20	16	N
Section Ship's Deck	2		7	17	0	55	52	30	S
Bright * in Lyon's Loins	2		7	22	21	14	19	4	N
Southern in Lyon's Buttock	3		9	30	31	9	39	50	N
Last but 1 Gr. Bear's Tail	2		11	44	0	56	23	15	N
Southern in Lyon's Thigh	3		13	38	0	6	5	10	N
Section Ship's Keel	2		15	2	18	57	11	11	S
Lyon's Tail	1		17	44	14	12	16	51	N
Bright * in Ship's Keel	2		19	17	10	72	39	32	S
Brightest bet. Bear's and Lyon's Tails	2		20	39	22	40	7	53	N
Last Gr. Bear's Tail	2		22	59	24	54	24	0	N
Bent of Southern Wing, Virgin	3		23	11	14	0	40	47	N
North. following Section Ship's Keel	3		24	59	30	63	42	23	S
Preceding in Southern Wing of Virgin	3	♎	0	55	52	1	22	1	N
South. following Section Ship's Keel	2		1	28	30	57	5	20	S
North. in Virg. Wing, *Vindematrix*	3		6	2	40	16	12	54	N
2d of Virgin's Southern Wing	3		6	17	11	2	48	53	N
Side, under Virgin's Girdle	3		7	34	54	8	38	27	N
Bootes preceding Shoulder	3		13	43	18	49	33	0	N
Spike of the Virgin	1		19	56	22	2	2	0	S
Brightest between Thighs of Bootes [*Arcturus*	1		20	18	52	30	57	0	N
Root of Caroline Oak	2		28	5	5	72	13	6	S
Bright * in Centaur's Loins	2		28	26	56	40	7	20	S
Pre. or hind Knee of Cent. *Bor. Crucis*	2	♏	2	51	9	47	45	51	S
Ancle of same Foot, Seq. *Crucis*	2		7	46	12	48	35	3	S
Following in lower Part Cent's. Foot	2		8	0	5	52	49	15	S
Bright * North. Crown [*Pes Crucis*	2		8	20	56	44	21	17	N
Southern Scale of Libra	2		11	11	40	0	22	51	N
Brightest in Centaur's Breast	2		11	38	20	39	32	0	S
Northern Scale of *Libra*	2		15	27	40	8	31	45	N
Bright * Serpent's Neck, *Ophiucus*	2		18	8	22	25	31	56	N
Left Knee, Centaur	2		19	54	30	44	4	47	S
Right Foot same	1		26	1	10	42	27	48	S
Brightest in left Hand *Ophiuchus*, *Ted*	3		28	23	15	17	17	15	N
Middle of 3 in Forehead of *Scorpion*	2		28	40	50	1	56	31	S
Southern among same	3		29	2	25	5	25	46	S
Northern in Forehead of Scorp.	2		29	17	56	1	3	9	N
Preceding Knee of *Ophiuchus*	3	♐	5	18	55	11	25	27	N
Scorpion's Heart, *Antares*	1		5	51	4	4	31	26	S
Head of *Hercules*	3		12	13	47	37	18	55	N
Following Knee, *Ophiuchus*	3		14	4	28	7	14	12	N
Point of Southern Triangle	2		16	56	27	46	5	33	S
Sole of the Foot, *Ophiuchus*	3		17	30	2	1	47	38	S
Head of *Ophiuchus*	3		18	30	32	35	53	16	N
Sting of Scorpion	2		20	40	0	13	43	25	S
Following Shoulder, Ophiuchus	3		21	25	44	27	58	0	N
Fifth Joint Scorpion's Tail	2		21	40	16	19	36	15	S
Bright * in Dragon's Head	2		24	0	35	74	58	26	N
Southern Part Bow, Sagittary	2	♑	1	10	33	10	59	54	S
Left Shoulder Sagittary	3		8	28	12	3	23	32	S
Armpit of Sagittary	3		9	42	22	7	7	55	S
Bright * in Harp	1		11	22	18	61	45	31	N
Following in Head, Sagittary	3		12	21	44	1	29	0	N
Peacock's *Eye*	2		19	53	56	36	11	0	S
Beak of the *Swan.*	3		27	20	37	49	0	31	N
Brightest of the *Eagle*	1		27	48	24	29	19	11	N
Following of several in Goat's Horn	3		29	57	21	6	58	6	N
Southern in same Horn	3	♒	0	8	57	4	37	27	N

N. B. Following *and* preceding *Shoulder*, *Thigh*, *Leg*, &c. *Signify the* Right *and* Left *Shoulder*, *Thigh*, *Leg*, &c.

I. CATALOGUE of remarkable STARS, continued, according to HALLEY.

Names of Stars.	Mag.	Longitude.	°	′	″	Latitude. °	′	″	S N
Preceding Wing of Crane	2	♒	11	56	35	32	50	22	S
Northern Wing of Swan	3		12	22	17	64	27	14	N
Preceding of 2 in Tail of the Goat	3		17	52	42	2	31	18	S
At Setting on of Crane's Tail	2		18	18	53	35	22	46	S
Preceding Shoulder Aquarius	3		19	29	23	8	38	43	N
Following in Tail of Goat	3		19	38	14	2	32	19	S
Breast of the Swan	3		20	57	51	57	9	20	N
Southern Wing of the Swan	3		23	47	52	49	26	21	N
Mouth of *Pegasus*	3		27	58	32	22	7	16	N
Following Shoulder of Aquarius	3		29	27	16	10	40	38	N

Names of Stars.	Mag.	Longitude.	°	′	″	Latitude. °	′	″	S N
In Mouth of the Fish, *Fomalhaut*	1	♒	29	54	0	21	4	54	S
Tail of the Swan	2	♓	1	26	32	59	56	37	N
In Leg of Aquarius, *Scheat*	3		4	58	49	8	11	17	S
Head of Hydra	2		7	59	0	64	11	0	S
At the End of the River, *Achernar*	1		11	14	6	59	19	40	S
Brightest in Head of *Phœnix*	2		11	30	27	40	34	10	S
In the Shou. of Pegasus Wing, *Markab.*	2		19	34	13	19	24	37	N
In Thigh of *Pegasus*, *Scheat*	2		25	27	13	31	8	6	N
Northern of the Whale's Tail.	3		27	0	0	10	0	41	S
Southern of the Whale's Tail	2		28	38	2	20	46	52	S

II. CATALOGUE of remarkable FIXED STARS, their R. ASCENSIONS and DECLINATIONS, for the Beginning of the YEAR 1756, OF immediate USE in ASTRONOMY and NAVIGATION. From the *Connoisance des Temps, published, in France, by Order of the Academy of Sciences there.*

Names of STARS and MAGNITUDE, according to *Bayer*.	Bayer.	Mag.	R. Ascen. Time. h	m	s	R. Ascen. Equator. °	′	″	Declin. °	′	″	N S
Algenib, *Pegasus*	γ	2	0	0	42	0	10	31	13	49	37	N
Cassiopea's Breast	α	3	0	26	44	6	42	2	55	11	38	N
Whale's Tail	β	2	0	31	14	7	49	59	19	19	42	S
Cassiopea's Girdle	γ	3	4	42	3	10	32	28	59	23	18	N
Polar Star	α	2	0	43	34	10	55	27	87	59	59	N
Andromeda's Girdle	β	2	0	55	51	13	59	59	34	19	12	N
Ram's Ear	γ	4	1	39	46	25	0	36	18	5	23	N
Preceding Horn of *Ram.*	β	3	1	40	47	25	16	0	19	36	23	N
Foot of *Andromeda.* Alam	γ	2	1	48	43	27	15	21	41	8	47	N
Following Horn of the *Ram*	α	3	1	53	10	28	22	5	22	17	55	N
Jaw of the *Whale*	α	2	2	49	6	42	23	15	3	7	1	N
Head of Medusa, *Algol*	β	2	2	51	15	43	5	50	39	59	46	N
Brightest of *Perseus*	α	2	3	6	32	46	45	40	48	58	9	N
Bull's Eye, *Aldebaran*	α	1	4	21	14	65	29	12	15	59	53	N
The Goat, *Capella*	α	1	4	57	53	74	40	32	45	43	9	N
Orion's Foot, *Rigel*	β	1	5	2	0	75	42	32	8	30	8	S
Northern Horn of Bull	β	2	5	10	1	77	43	7	28	22	32	N
West Shoulder of *Orion*	γ	2	5	11	12	78	0	52	6	6	21	N
1st of *Orion*'s Belt	[illegible]	2	5	18	42	79	53	31	0	30	2	S
2d	[illegible]	2	5	22	58	80	57	46	1	22	42	S
3d	ζ	2	5	27	35	82	7	7	2	5	32	S
Auriga's Shoulder	β	2	5	40	42	85	24	35	44	53	26	N
Eastern Shoulder of *Orion*	α	1	5	41	2	85	29	39	7	20	20	N
Brightest Foot of *Twins*	[illegible]	2	6	22	33	95	54	8	16	35	5	N
Great Dog, *Sirius*	α	1	6	33	19	98	36	2	16	23	54	S
Northern Head of *Twins*	α	2	7	17	47	109	44	51	32	23	54	N
Little Dog, *Procyon*	α	2	7	25	18	111	37	48	5	49	58	N
Southern Head of *Twins*	β	2	7	29	8	112	35	23	28	35	37	N
Hydra's Heart	α	2	9	14	5	138	54	6	7	36	44	S
Lyon's Heart, *Regulus*	α	1	9	53	44	148	50	18	13	9	1	N
The Great Bear	β	2	10	45	10	161	44	4	57	40	57	N
Ditto	α	2	10	46	40	162	6	35	63	3	4.	N
Breast of the *Lion*	[illegible]	2	11	34	42	174	8	58	15	56	8	N
Thigh of the Gr. *Bear*	γ	2	11	38	57	175	12	59	55	3	1	N
Of the Gr. Bear	δ	3	12	1	16	180	48	42	58	23	19	N
1 of the Breast of G. Bear		3	12	41	7	190	48	8	57	17	17	N

Names of STARS and MAGNITUDE, according to *Bayer*.	Bayer.	Mag.	R. Ascen. Time. h	m	s	R. Ascen. Equator. °	′	″	Declin. °	′	″	N S
Wing of the Virgin	ε	3	12	47	55	192	30	22	12	16	37	N
Spike of the Virgin	α	1	13	19	12	198	5	35	9	52	45	S
2d of the Breast of G. Bear	ζ	2	13	11	52	198	30	34	56	12	18	N
3d of the Br. of Gr. Bear	η	2	13	35	40	204	28	36	50	32	16	N
Arcturus	α	1	14	2	14	211	8	15	20	27	56	N
Southern Scale of *Ballance*	α	2	14	35	1	219	21	18	15	0	43	S
Shoulder of little Bear	β	2	14	49	14	222	55	10	75	9	7	N
Northern *Scale* of *Ballance*	β	2	15	1	27	225	58	47	8	27	54	S
Brightest of the *Crown*	α	2	15	21	47	231	4	45	27	33	3	N
Brightest in Serpent's Neck	α	2	15	29	48	233	4	11	7	12	37	N
Northern in Front *Scorpion*	β	2	15	48	39	237	48	52	19	6	59	S
Scorpion's Heart, *Antares*	α	1	16	11	50	243	37	22	25	52	2	S
Knee of *Serpentarius*	ζ	3	16	21	4	245	56	16	10	3	5	S
Head of *Hercules*	α	3	17	0	44	255	52	56	14	41	15	N
Head of *Serpentarius*	α	2	17	20	46	260	54	16	12	45	29	N
Preceding in H. of *Dragon*	β	3	16	22	5	261	14	9	52	29	26	N
Shoulder of *Serpentarius*	β	3	17	28	33	262	51	22	4	41	25	N
Bright. of the H. of Dragon	γ	3	17	48	6	267	45	22	51	32	33	N
Southern Bow of *Sagittary*	ε	3	11	5	0	271	59	40	34	28	13	S
Brightest of the Harp, *Wega*	[illegible]	1	18	25	29	277	10	12	38	34	15	N
Fol. Shoulder of *Sagittary*	σ	3	18	37	14	280	1	50	26	34	30	S
Brightest in the *Eagle*	α	2	19	35	39	294	43	9	8	14	34	N
Following Horn of *Goat*	β	2	20	13	59	301	49	8	15	31	59	S
Breast of the *Swan*	α	2	20	29	45	308	16	43	44	25	9	N
Pre. Shoulder of *Aquarius*	[illegible]	3	21	15	13	319	40	40	6	37	50	S
Mouth of *Pegasus*	ε	3	21	28	39	323	2	47	8	46	6	N
Following in Breast of *Goat*	δ	3	21	30	1	323	23	8	17	13	12	S
Scheat ♒	δ	3	22	37	57	340	25	5	17	6	47	S
Southern Fish, *Fomahaut*	α	1	22	40	23	341	1	42	30	54	31	S
Scheat, Pegasus	β	2	22	48	13	342	59	35	26	45	48	N
Markab, Pegasus	α	1	22	48	53	343	9	26	13	53	51	N
Head of *Andromeda*	α	2	23	51	54	358	47	0	27	44	32	N
Fol. the Chair of *Cassiopea*	β	2	23	52	21	359	4	15	57	48	7	N

☞ Enquire at *Jonathan*'s Coffee-House, near the *Royal Exchange*, *London*, for the *Secret Astronomical Tables* from *Greenwich* Observations, (3 printed Sheets) by Mr. *Gael Morris.*

REMARK. *We are obliged to insert the foregoing and other foreign* astronomical *Observations and Improvements, because our present* astronomical Professors *do not publish their Observations for the Improvement of Astronomy, and Benefit of this Nation: though they are paid, with the public Money,* that we may see and taste the Fruit *of their Industry.— Our late astronomical Professor*, Dr. Edm. Halley, *published an* excellent Ephemerides, *we are told, for the Use of* our Royal Society, *whereby our Astronomy must be* then *greatly improved. But* (by our present astronomical Professors making an *impenetrable Secret* of their Observations and Improvements) *this Nation is obliged to send to* France *for* Ephemerides, *published by M. De* Caille, Miraldi, *and* others there, *for their Accuracy and Improvement; because our able* astronomical Professors suffer themselves to be exceeded herein by Foreigners, *and these Sort of* curious *and useful Productions are now not encouraged among us.* — Whereas if proper Encouragement were given us by our NOBILITY, or the ROYAL SOCIETY of this Nation, we would undertake to compute A ROYAL EPHEMERIDES (for many Years to come) to *improve the Theory of the celestial Motions*, and to *excell in Usefulness*, — Observations being, at the same Time, allowed us. Then we need not send our Money abroad for *foreign Manufacture*; having sufficient of our *own.*

EQUATION of MIDDLE TIME, between the *Times* of *Forenoon* and *Afternoon* Obfervations of the *fame Height* of the SUN, (marked by *the Clock* or Watch) to the correct NOON by the SUN: Correfpondent to the *Increafe* or *Decreafe* of Day, or of Sun's Declination, in that INTERVAL: Being the METHOD of *correfponding* ALTITUDES.

From *Dec.* 21, to *June* 22, *N. S.* Days increafe; therefore *Mid-Time*, — Equation = Time of correct Noon } by the SUN.
From *June* 22, to *Dec.* 21, *N. S.* Days decreafe; therefore *Mid-Time*, + Equation = Time of correct Noon } by the SUN.

N.S. Dec. ☉	Lat. N. or S. 20° Hrs. betw. Obfer.						Lat. N. or S. 30° Hours between Obferv.						Lat. N. or S. 40° Hours between Obferv.							Lat. N. or S. 50° Hours between Obferv.							Lat. N. or S. 60° of the ☉ Hours between Obferv.						
	9	8	7	6	5	4	9	8	7	6	5	4	10	9	8	7	6	5	4	10	9	8	7	6	5	4	10	9	8	7	6	5	4
N S.	Se	Se	Se	Se	Se	Se	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Sec	Se	Se
23°	1	0	0	0	0	0	2	1	1	0	0	0	3	3	2	2	2	1	0	4	4	3	3	3	2	2	7	6	6	5	5	5	4
22	1	1	0	0	0	0	3	2	2	1	1	0	5	4	4	4	3	2	2	8	7	7	6	5	5	5	12	11	10	9	8	8	8
21	2	1	1	1	0	0	4	3	3	2	2	1	7	6	5	5	4	3	3	10	9	8	8	7	6	6	15	14	13	13	12	11	10
20	2	2	1	1	1	0	4	4	3	3	2	2	8	7	6	6	5	5	4	11	11	10	9	8	8	7	18	16	15	14	14	13	12
19	3	2	2	1	1	1	5	4	4	3	3	2	9	8	7	7	6	5	5	13	12	11	10	9	9	8	20	18	17	16	15	14	13
18	3	2	2	1	1	1	5	5	4	4	[illegible]	3	10	9	8	8	6	6	5	14	13	12	11	10	10	[illegible]	21	20	18	17	16	15	15
17	4	3	2	2	2	1	6	5	5	4	[illegible]	3	11	10	9	8	7	7	6	15	14	13	12	11	11	10	23	21	20	19	17	17	16
16	4	3	3	2	2	1	6	5	5	5	4	4	11	10	9	9	8	7	7	16	15	14	13	12	12	11	24	23	21	20	18	18	17
15	4	3	3	3	2	2	7	6	5	5	5	4	12	11	10	9	8	8	7	17	16	15	13	13	12	12	26	24	22	21	19	19	18
14	4	4	3	3	2	2	7	6	6	5	5	5	12	11	10	10	9	8	8	18	17	16	14	13	13	12	—	26	23	22	20	20	19
13	5	4	3	3	3	2	7	7	6	6	5	5	13	12	11	10	9	9	8	19	18	17	15	14	14	13	—	27	24	23	21	21	20
12	5	4	4	3	3	[illegible]	7	7	6	6	6	5	13	12	11	11	10	9	9	20	19	17	16	15	14	14	—	28	25	23	22	21	21
11	5	4	4	4	3	3	8	7	7	6	[illegible]	5	14	13	12	11	10	10	9	20	19	18	16	15	15	14	—	30	26	24	23	22	22
10	5	5	4	4	3	3	8	8	7	7	[illegible]	5	14	13	12	11	11	10	10	21	20	18	17	16	15	15	—	31	[illegible]	25	24	23	22
9	5	5	4	4	4	[illegible]	8	8	7	7	6	4	15	14	12	12	11	10	10	21	20	19	17	16	15	15	—	—	28	26	25	23	23
8	5	5	4	4	4	3	9	8	8	7	7	4	15	14	13	12	11	11	10	21	21	19	18	17	16	16	—	—	28	27	26	24	23
7	6	5	5	5	4	4	[illegible]	8	[illegible]	[illegible]	[illegible]	[illegible]	16	14	13	12	12	11	11	22	21	20	18	17	16	16	—	—	29	27	26	25	24
6	6	5	5	[illegible]	[illegible]	[illegible]	[illegible]	9	[illegible]	[illegible]	7	[illegible]	16	15	[illegible]	13	12	11	11	22	22	20	19	17	[illegible]	[illegible]	—	—	[illegible]	28	27	25	24
5	6	6	5	[illegible]	4	[illegible]	9	9	[illegible]	[illegible]	7	[illegible]	16	[illegible]	14	13	12	12	11	23	22	20	19	18	17	17	—	—	29	28	27	26	25
4	6	6	5	5	[illegible]	[illegible]	10	9	[illegible]	[illegible]	[illegible]	7	17	15	14	13	13	12	12	23	22	20	19	18	17	17	—	—	30	29	27	26	25
3	6	[illegible]	6	5	[illegible]	5	[illegible]	[illegible]	9	8	8	7	17	15	14	14	13	12	12	23	22	21	20	18	18	17	—	—	30	29	28	27	26
2	6	6	6	5	5	5	[illegible]	9	9	9	8	8	17	16	14	14	13	13	12	23	22	21	20	19	18	18	—	—	30	29	28	27	26
1	7	6	6	5	5	5	[illegible]	[illegible]	[illegible]	9	9	8	17	16	15	14	[illegible]	13	12	23	22	21	20	19	19	18	—	—	31	29	28	27	27
0	[illegible]	[illegible]	6	6	[illegible]	[illegible]	[illegible]	[illegible]	10	9	[illegible]	8	17	16	15	14	[illegible]	13	13	23	22	21	21	20	[illegible]	18	—	—	31	29	28	28	17
S N																																	
0°	7	[illegible]	[illegible]	6	5	5	10	10	10	9	9	8	—	16	15	14	14	13	13	—	22	21	21	20	19	18	—	—	—	29	28	28	27
1	7	6	6	[illegible]	6	6	10	10	10	9	9	9	—	16	15	14	14	13	13	—	22	21	21	20	19	18	—	—	—	29	29	28	27
2	7	[illegible]	[illegible]	6	6	6	11	10	10	[illegible]	9	9	—	16	15	15	14	14	13	—	22	22	21	20	19	18	—	—	—	30	29	28	27
3	7	7	[illegible]	[illegible]	6	6	11	10	10	10	9	9	—	16	15	15	14	14	13	—	—	22	21	20	19	18	—	—	—	30	29	28	27
4	7	7	7	[illegible]	6	6	11	10	10	10	10	9	—	16	15	15	14	14	13	—	—	22	21	20	19	19	—	—	—	30	29	29	28
5	7	7	7	6	7	6	11	10	10	10	10	10	—	16	16	15	15	14	14	—	—	22	21	20	19	19	—	—	—	30	29	29	28
6	—	7	7	7	7	7	—	10	10	10	10	10	—	—	16	15	15	14	14	—	—	—	21	20	20	19	—	—	—	—	29	29	28
7	—	7	7	7	7	7	—	10	10	10	10	10	—	—	16	16	15	14	14	—	—	—	21	20	20	19	—	—	—	—	29	28	27
8	—	7	7	7	7	7	—	10	10	10	10	10	—	—	16	16	15	14	14	—	—	—	21	20	20	19	—	—	—	—	29	28	27
9	—	7	7	7	7	7	—	10	10	10	10	10	—	—	16	15	15	15	14	—	—	—	21	20	20	19	—	—	—	—	28	28	27
10	—	8	8	7	7	7	—	11	10	10	10	10	—	—	16	15	15	15	14	—	—	—	—	20	19	19	—	—	—	—	28	28	27
11	—	7	7	8	7	7	—	11	11	10	10	10	—	—	15	15	14	14	14	—	—	—	—	19	19	18	—	—	—	—	—	27	27
12	—	7	7	7	7	7	—	10	11	10	10	10	—	—	15	15	14	14	14	—	—	—	—	19	19	18	—	—	—	—	—	27	26
13	—	7	7	7	7	7	—	10	10	10	10	9	—	—	15	14	14	14	14	—	—	—	—	19	19	18	—	—	—	—	—	26	26
14	—	7	7	7	7	7	—	10	10	10	9	9	—	—	15	14	14	14	14	—	—	—	—	18	18	17	—	—	—	—	—	25	25
15	—	7	7	7	7	7	—	10	10	9	9	9	—	—	14	14	14	14	13	—	—	—	—	18	18	17	—	—	—	—	—	—	24
16	—	—	6	6	6	6	—	—	9	9	9	9	—	—	—	13	13	13	13	—	—	—	—	17	17	17	—	—	—	—	—	—	23
17	—	—	6	6	6	6	—	—	9	9	9	8	—	—	—	13	12	12	12	—	—	—	—	16	16	16	—	—	—	—	—	—	22
18	—	—	6	6	6	6	—	—	9	9	8	8	—	—	—	12	12	12	12	—	—	—	—	15	15	15	—	—	—	—	—	—	21
19	—	—	6	6	6	6	—	—	8	8	8	8	—	—	—	11	11	11	11	—	—	—	—	14	14	14	—	—	—	—	—	—	19
20	—	—	5	5	5	5	—	—	8	8	7	7	—	—	—	10	10	10	10	—	—	—	—	13	13	13	—	—	—	—	—	—	17
21	—	—	5	5	5	5	—	—	7	7	7	7	—	—	—	—	9	9	9	—	—	—	—	—	11	11	—	—	—	—	—	—	14
22	—	—	4	4	4	4	—	—	6	6	6	5	—	—	—	—	7	7	7	—	—	—	—	—	9	9	—	—	—	—	—	—	11
23	—	—	2	2	2	2	—	—	3	3	3	3	—	—	—	—	4	4	4	—	—	—	—	—	5	5	—	—	—	—	—	—	7

EXAMPLE. *To find the Clock-Time of the correct Noon, by the* SUN, for *Latitude of* Greenwich 51° 30′ 28″, *on 20th Jan.* (☉ 20° Declination South) *from* ☉*'s Altitude obferved* 10° 40*s*, *at* 9h 28m 19s *Forenoon, and again at* 2h 38m 45s *Afternoon, by the fame Clock or Watch, by which a Clock or Watch is regulated to the Sun's Time?*

	h	m	s		
	12	0	0		
1ft Obferv. . .	9	28	19—		
	2	31	41	before 12	by the fame Clock or Watch, fhewn to be fafter than the ☉, by 2d Dift. being greater than 1ft.
2d Obferv. . .	2	38	45	fince 12	
Sum . . .	5	10	26	Time between Obfervations.	
½ . .	2	35	13		
+ Time, 1ft Obferv.	12	3	32	Middle-Time, or near SUN's Noon, by the Clock.	

	h	m	s
Middle-Time found	12	3	32
Lat. 50°. Under 5h between Obfervations againft 20° South Declination, Equation at Noon,			—13
	12	3	19

☞ Hence the Clock or Watch may be kept going with the *Sun*, at 12. . . . . 12 3 19

For finding the Time of Rising and Setting of the Sun and Stars.

SEMIDIURNAL OR DURATION ARCS.

N.S. North or South Latitude of the Place, correspondent to N. S. Declination of Sun or Star.

☉ or ✱'s Dec.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°
N.S.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	6 2	6 2	6 2	6 2	6 2	6 3	6 3	6 3	6 3	6 3	6 3	6 3	6 3	6 3	6 3	6 3	6 3
2	6 2	6 2	6 3	6 3	6 3	6 3	6 3	6 3	6 3	6 4	6 4	6 4	6 4	6 4	6 4	6 4	6 5
3	6 2	6 3	6 3	6 3	6 3	6 3	6 4	6 4	6 4	6 4	6 4	6 5	6 5	6 5	6 5	6 6	6 6
4	6 2	6 3	6 3	6 3	6 4	6 4	6 4	6 4	6 5	6 5	6 5	6 6	6 6	6 6	6 6	6 7	6 7
5	6 2	6 3	6 3	6 4	6 4	6 4	6 5	6 5	6 5	6 6	6 6	6 6	6 7	6 7	6 8	6 8	6 8
6	6 3	6 3	6 3	6 4	6 4	6 4	6 5	6 6	6 6	6 6	6 7	6 7	6 8	6 8	6 9	6 9	6 10
7	6 3	6 3	6 4	6 4	6 5	6 5	6 6	6 6	6 7	6 7	6 8	6 8	6 9	6 9	6 10	6 10	6 11
8	6 3	6 3	6 4	6 4	6 5	6 5	6 6	6 7	6 7	6 8	6 8	6 9	6 10	6 10	6 11	6 11	6 12
9	6 3	6 3	6 4	6 4	6 5	6 6	6 7	6 7	6 8	6 9	6 9	6 10	6 11	6 11	6 12	6 13	6 13
10	6 3	6 4	6 4	6 5	6 6	6 6	6 7	6 8	6 9	6 9	6 10	6 11	6 12	6 12	6 13	6 14	6 15
11	6 3	6 4	6 4	6 5	6 6	6 7	6 8	6 8	6 9	6 10	6 11	6 12	6 13	6 13	6 14	6 15	6 16
12	6 3	6 4	6 5	6 6	6 6	6 7	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 14	6 15	6 16	6 17
13	6 3	6 4	6 5	6 6	6 7	6 8	6 9	6 10	6 11	6 12	6 12	6 13	6 15	6 15	6 16	6 17	6 18
14	6 3	6 4	6 5	6 6	6 7	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 18	6 19	6 20
15	6 3	6 4	6 5	6 6	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 18	6 19	6 20	6 21
16	6 3	6 4	6 6	6 7	6 8	6 9	6 10	6 11	6 13	6 14	6 15	6 16	6 17	6 19	6 20	6 21	6 22
17	6 3	6 5	6 6	6 7	6 8	6 10	6 11	6 12	6 13	6 15	6 16	6 17	6 18	6 20	6 21	6 22	6 24
18	6 4	6 5	6 6	6 7	6 9	6 10	6 11	6 13	6 14	6 15	6 17	6 18	6 19	6 21	6 22	6 24	6 25
19	6 4	6 5	6 6	6 8	6 9	6 11	6 12	6 13	6 15	6 16	6 18	6 19	6 21	6 22	6 23	6 25	6 27
20	6 4	6 5	6 7	6 8	6 9	6 11	6 12	6 14	6 15	6 17	6 19	6 20	6 22	6 23	6 25	6 26	6 28
21	6 4	6 5	6 7	6 8	6 10	6 12	6 13	6 15	6 16	6 18	6 19	6 21	6 23	6 24	6 26	6 28	6 29
22	6 4	6 6	6 7	6 8	6 10	6 12	6 14	6 15	6 17	6 19	6 20	6 22	6 24	6 25	6 27	6 29	6 31
23	6 4	6 6	6 7	6 9	6 11	6 13	6 14	6 16	6 18	6 19	6 21	6 23	6 25	6 27	6 28	6 30	6 32
24	6 4	6 6	6 8	6 9	6 11	6 13	6 15	6 17	6 19	6 20	6 22	6 24	6 26	6 28	6 30	6 32	6 34
25	6 4	6 6	6 8	6 10	6 12	6 14	6 15	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 31	6 33	6 35
26	6 4	6 6	6 8	6 10	6 12	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 28	6 30	6 32	6 35	6 37
27	6 4	6 6	6 8	6 11	6 13	6 15	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 32	6 34	6 36	6 38
28	6 5	6 7	6 9	6 11	6 13	6 15	6 17	6 20	6 22	6 24	6 26	6 28	6 31	6 33	6 35	6 38	6 40
29	6 5	6 7	6 9	6 11	6 14	6 16	6 18	6 20	6 23	6 25	6 27	6 30	6 32	6 34	6 37	6 39	6 42
30	6 5	6 7	6 9	6 12	6 14	6 16	6 17	6 21	6 23	6 26	6 28	6 31	6 3[illegible]	6 36	6 38	6 41	6 45
31	6 5	6 7	6 10	6 12	6 15	6 17	6 19	6 22	6 24	6 27	6 29	6 32	6 34	6 37	6 40	6 42	6 45
32	6 5	6 7	6 10	6 12	6 15	6 18	6 20	6 23	6 25	6 28	6 30	6 33	6 [illegible]	6 3[illegible]	6 41	6 44	[illegible]
S.N.																	
1	6 2	6 2	6 2	6 2	6 2	6 2	6 3	6 1	6 1	6 1	6 1	6 1	6 1	6 1	6 1	6 1	6 1
2	6 2	6 1	6 1	6 1	6 1	6 1	6 3	6 1	6 1	6 1	6 1	6 0	6 0	6 0	6 0	6 0	6 0
3	6 2	6 1	6 1	6 1	6 1	6 1	6 4	6 0	6 0	6 0	6 0	6 0	5 59	5 59	5 59	5 59	5 59
4	6 2	6 1	6 1	6 1	6 1	6 0	6 4	6 0	6 0	5 59	5 59	5 59	5 59	5 58	5 58	5 58	5 57
5	6 2	6 1	6 1	6 1	6 0	6 0	6 5	5 59	5 59	5 59	5 58	5 58	5 57	5 57	5 57	5 56	5 56
6	6 2	6 1	6 1	6 0	6 0	6 0	6 5	5 59	5 58	5 58	5 57	5 57	5 57	5 56	5 56	5 55	5 55
7	6 2	6 1	6 1	6 0	6 0	5 59	6 6	5 58	5 58	5 57	5 57	5 56	5 56	5 55	5 55	5 54	5 54
8	6 1	6 1	6 0	6 0	5 59	5 59	6 6	5 57	5 57	5 56	5 56	5 55	5 55	5 54	5 54	5 53	5 52
9	6 1	6 1	6 0	6 0	5 59	5 58	6 7	5 56	5 57	5 56	5 55	5 54	5 54	5 53	5 5[illegible]	5 52	5 51
10	6 1	6 1	6 0	5 59	5 59	5 58	6 7	5 56	5 56	5 55	5 54	5 54	5 53	5 52	5 51	5 51	5 50
11	6 1	6 1	6 0	5 59	5 58	5 57	6 8	5 56	5 55	5 54	5 54	5 53	5 52	5 51	5 50	5 49	5 49
12	6 1	6 1	6 0	5 59	5 58	5 57	6 8	5 55	5 54	5 54	5 53	5 52	5 51	5 50	5 49	5 48	5 47
13	6 1	6 0	5 59	5 58	5 57	5 57	6 9	5 55	5 54	5 53	5 52	5 51	5 50	5 49	5 48	5 47	5 46
14	6 1	6 0	5 59	5 58	5 57	5 56	6 9	5 54	5 53	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 45
15	6 1	6 0	5 59	5 58	5 57	5 56	6 10	5 54	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 45	5 43
16	6 1	6 0	5 59	5 58	5 56	5 55	6 10	5 53	5 52	5 51	5 49	5 48	5 47	5 46	5 45	5 43	5 42
17	6 1	6 0	5 59	5 57	5 56	5 55	6 11	5 52	5 51	5 50	5 49	5 47	5 46	5 45	5 43	5 42	5 41
18	6 1	6 0	5 58	5 57	5 56	5 54	6 11	5 52	5 50	5 49	5 48	5 46	5 45	5 44	5 42	5 41	5 40
19	6 1	5 59	5 58	5 57	5 55	5 54	6 12	5 51	5 50	5 48	5 47	5 45	5 44	5 43	5 41	5 40	5 38
20	6 1	5 59	5 58	5 56	5 55	5 53	6 12	5 51	5 49	5 48	5 46	5 45	5 43	5 41	5 40	5 38	5 37
21	6 1	5 59	5 58	5 56	5 55	5 53	6 13	5 50	5 48	5 47	5 45	5 44	5 42	5 40	5 39	5 37	5 35
22	6 1	5 59	5 57	5 56	5 54	5 53	6 14	5 49	5 48	5 46	5 44	5 43	5 41	5 39	5 38	5 36	5 34
23	6 1	5 59	5 57	5 55	5 54	5 52	6 14	5 49	5 47	5 45	5 43	5 42	5 40	5 38	5 36	5 34	5 33
24	6 1	5 59	5 57	5 55	5 53	5 52	6 15	5 48	5 46	5 44	5 42	5 41	5 39	5 37	5 35	5 33	5 31
25	6 1	5 59	5 57	5 55	5 53	5 51	6 15	5 47	5 45	5 43	5 42	5 40	5 3[illegible]	5 36	5 34	5 3[illegible]	5 30
26	6 0	5 58	5 56	5 55	5 53	5 51	6 1[illegible]	5 47	5 45	5 43	5 41	5 39	5 37	5 34	5 3[illegible]	[illegible] 30	5 28
27	6 0	5 58	5 56	5 54	5 52	5 50	6 17	5 46	5 44	5 42	5 40	5 38	5 36	5 33	5 31	5 29	5 26
28	6 0	5 58	5 56	5 54	5 52	5 50	6 17	5 45	5 43	5 41	5 39	5 37	5 34	5 32	5 30	5 27	5 25
29	6 0	5 58	5 56	5 54	5 51	5 49	6 18	5 45	5 42	5 40	5 38	5 36	5 33	5 31	5 28	5 26	5 24
30	6 0	5 58	5 55	5 53	5 51	5 49	6 19	5 44	5 41	5 39	5 37	5 35	5 32	5 29	5 27	5 24	5 22
31	6 0	5 58	5 55	5 53	5 50	5 48	6 19	5 43	5 41	5 38	5 36	5 34	5 31	5 28	5 26	5 23	5 20
32	6 0	5 57	5 55	5 52	5 50	5 47	6 20	5 43	5 40	5 37	5 35	5 32	5 29	5 27	5 24	5 21	[illegible]

For finding the Time of Rising and Setting of the Sun and Stars.

SEMIDIURNAL or DURATION ARCS.

N.S. ☉ or ✱'s Dec.	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°	31°	32°	33°	34°
	North or South Latitude of the Place, correspondent to N. S. Declination of Sun or Star.																
N.S	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1°	6 4	6 4	6 4	6 4	6 4	6 4	6 4	6 4	6 4	6 4	6 5	6 5	6 5	6 5	6 5	6 5	6 5
2	6 5	6 5	6 5	6 5	6 6	6 6	6 6	6 6	6 6	6 6	6 7	6 7	6 7	6 7	6 7	6 8	6 8
3	6 6	6 6	6 7	6 7	6 7	6 7	6 8	6 8	6 8	6 8	6 9	6 9	6 9	6 10	6 10	6 10	6 11
4	6 7	6 8	6 8	6 8	6 8	6 9	6 9	6 10	6 10	6 11	6 11	6 11	6 11	6 12	6 12	6 13	6 13
5	6 9	6 9	6 9	6 10	6 10	6 11	6 11	6 12	6 12	6 13	6 13	6 14	6 14	6 15	6 15	6 16	6 16
6	6 10	6 11	6 11	6 12	6 12	6 13	6 13	6 14	6 14	6 15	6 15	6 16	6 16	6 17	6 18	6 18	6 19
7	6 11	6 12	6 12	6 13	6 14	6 14	6 15	6 15	6 16	6 17	6 17	6 18	6 19	6 19	6 20	6 21	6 22
8	6 13	6 13	6 14	6 15	6 15	6 16	6 17	6 17	6 18	6 19	6 20	6 20	6 21	6 22	6 23	6 23	6 24
9	6 14	6 15	6 15	6 16	6 17	6 18	6 19	6 19	6 20	6 21	6 22	6 23	6 23	6 24	6 25	6 26	6 27
10	6 15	6 16	6 17	6 18	6 19	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 27	6 28	6 29	6 30
11	6 17	6 18	6 19	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 27	6 28	6 29	6 30	6 32	6 33
12	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 27	6 28	6 30	6 31	6 32	6 33	6 34	6 36
13	6 19	6 21	6 22	6 23	6 24	6 25	6 26	6 27	6 28	6 30	6 31	6 32	6 33	6 34	6 36	6 37	6 38
14	6 21	6 22	6 23	6 24	6 25	6 27	6 28	6 29	6 30	6 32	6 33	6 34	6 36	6 37	6 38	6 40	6 41
15	6 22	6 23	6 25	6 26	6 27	6 28	6 30	6 31	6 32	6 34	6 35	6 37	6 38	6 40	6 41	6 43	6 44
16	6 24	6 25	6 26	6 28	6 29	6 30	6 32	6 33	6 35	6 36	6 38	6 39	6 41	6 42	6 44	6 46	6 47
17	6 25	6 27	6 28	6 29	6 31	6 32	6 34	6 35	6 37	6 38	6 40	6 42	6 43	6 45	6 47	6 48	6 50
18	6 27	6 28	6 30	6 31	6 33	6 34	6 36	6 37	6 39	6 41	6 42	6 44	6 46	6 48	6 50	6 51	6 53
19	6 28	6 30	6 31	6 33	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 47	6 48	6 50	6 52	6 54	6 56
20	6 30	6 31	6 33	6 35	6 36	6 38	6 40	6 42	6 43	6 45	6 47	6 49	6 51	6 53	6 55	6 57	7 0
21	6 31	6 33	6 35	6 36	6 38	6 40	6 42	6 44	6 46	6 48	6 50	6 52	6 54	6 56	6 58	7 0	7 3
22	6 33	6 34	6 36	6 38	6 40	6 42	6 44	6 46	6 48	6 50	6 52	6 54	6 57	6 59	7 1	7 4	7 6
23	6 34	6 36	6 38	6 40	6 42	6 44	6 46	6 48	6 50	6 53	6 55	6 57	6 59	7 2	7 4	7 7	7 9
24	6 36	6 38	6 40	6 42	6 44	6 46	6 48	6 51	6 53	6 55	6 57	7 0	7 2	7 5	7 7	7 10	7 13
25	6 37	6 39	6 42	6 44	6 46	6 48	6 51	6 53	6 55	6 58	7 0	7 3	7 5	7 8	7 11	7 13	7 16
26	6 39	6 41	6 43	6 46	6 48	6 50	6 53	6 55	6 58	7 0	7 3	7 6	7 8	7 11	7 14	7 17	7 20
27	6 41	6 43	6 45	6 48	6 50	6 53	6 55	6 58	7 0	7 3	7 6	7 8	7 11	7 14	7 17	7 20	7 23
28	6 42	6 45	6 47	6 50	6 52	6 55	6 57	7 0	7 3	7 6	7 8	7 11	7 14	7 17	7 21	7 24	7 27
29	6 44	6 47	6 49	6 52	6 54	6 57	7 0	7 3	7 6	7 9	7 11	7 14	7 18	7 21	7 24	7 28	7 31
30	6 46	6 48	6 51	6 54	6 57	6 59	7 2	7 5	7 8	7 11	7 14	7 18	7 21	7 24	7 28	7 31	7 35
31	6 48	6 50	6 53	6 56	6 59	7 2	7 5	7 8	7 11	7 14	7 17	7 21	7 24	7 28	7 31	7 35	7 39
32	6 50	6 52	6 55	6 58	7 1	7 4	7 7	7 11	7 14	7 17	7 21	7 24	7 28	7 31	7 35	7 39	7 43
S.N.																	
1	6 1	6 1	6 1	6 1	6 1	6 1	6 1	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0
2	6 0	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 58	5 58	5 58	5 58	5 58	5 58	5 57	5 57	5 57
3	5 58	5 58	5 58	5 58	5 57	5 57	5 57	5 57	5 56	5 56	5 56	5 56	5 55	5 55	5 55	5 55	5 54
4	5 57	5 57	5 56	5 56	5 56	5 55	5 55	5 55	5 55	5 54	5 54	5 54	5 53	5 53	5 52	5 52	5 52
5	5 56	5 55	5 55	5 55	5 54	5 54	5 53	5 53	5 53	5 52	5 52	5 51	5 51	5 50	5 50	5 49	5 49
6	5 54	5 54	5 53	5 53	5 53	5 52	5 52	5 51	5 51	5 50	5 50	5 49	5 49	5 48	5 47	5 47	5 46
7	5 53	5 53	5 52	5 51	5 51	5 50	5 50	5 49	5 49	5 48	5 47	5 47	5 46	5 46	5 45	5 44	5 44
8	5 52	5 51	5 51	5 50	5 49	5 49	5 48	5 47	5 47	5 46	5 45	5 45	5 44	5 43	5 43	5 42	5 41
9	5 50	5 50	5 49	5 48	5 48	5 47	5 46	5 45	5 45	5 44	5 43	5 42	5 41	5 41	5 40	5 39	5 38
10	5 49	5 48	5 48	5 47	5 46	5 45	5 44	5 43	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 35
11	5 48	5 47	5 46	5 45	5 44	5 43	5 42	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 34	5 32
12	5 46	5 45	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 36	5 36	5 35	5 34	5 32	5 31	5 30
13	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 34	5 33	5 32	5 31	5 29	5 28	5 27
14	5 44	5 43	5 41	5 40	5 39	5 38	5 37	5 36	5 34	5 33	5 32	5 31	5 29	5 28	5 27	5 25	5 24
15	5 42	5 41	5 40	5 39	5 38	5 36	5 35	5 34	5 32	5 31	5 30	5 28	5 27	5 26	5 24	5 23	5 21
16	5 41	5 40	5 38	5 37	5 36	5 34	5 33	5 32	5 30	5 29	5 27	5 26	5 24	5 23	5 21	5 20	5 18
17	5 40	5 38	5 37	5 35	5 34	5 33	5 31	5 30	5 28	5 26	5 25	5 24	5 22	5 20	5 19	5 17	5 15
18	5 38	5 37	5 35	5 34	5 32	5 31	5 29	5 28	5 26	5 24	5 23	5 21	5 19	5 18	5 16	5 14	5 12
19	5 37	5 35	5 34	5 32	5 30	5 29	5 27	5 26	5 24	5 22	5 21	5 19	5 17	5 15	5 13	5 11	5 9
20	5 35	5 34	5 32	5 30	5 29	5 27	5 25	5 24	5 22	5 20	5 18	5 16	5 14	5 12	5 10	5 8	5 6
21	5 34	5 32	5 30	5 28	5 27	5 25	5 23	5 21	5 19	5 17	5 15	5 13	5 11	5 9	5 7	5 5	5 3
22	5 32	5 30	5 29	5 27	5 25	5 23	5 21	5 19	5 17	5 15	5 13	5 11	5 9	5 7	5 4	5 2	5 0
23	5 31	5 29	5 27	5 25	5 23	5 21	5 19	5 17	5 15	5 13	5 10	5 8	5 6	5 4	5 1	4 59	4 56
24	5 29	5 27	5 25	5 23	5 21	5 19	5 17	5 15	5 12	5 10	5 8	5 6	5 3	5 1	4 58	4 56	4 53
25	5 28	5 26	5 24	5 21	5 19	5 17	5 15	5 12	5 10	5 8	5 5	5 3	5 0	4 58	4 55	4 52	4 50
26	5 26	5 24	5 22	5 19	5 17	5 15	5 12	5 10	5 8	5 5	5 3	5 0	4 57	4 55	4 52	4 49	4 46
27	5 24	5 22	5 20	5 17	5 15	5 13	5 10	5 8	5 5	5 3	5 0	4 57	4 54	4 52	4 49	4 46	4 43
28	5 22	5 21	5 18	5 15	5 13	5 10	5 8	5 5	5 3	5 0	4 57	4 54	4 51	4 48	4 45	4 42	4 39
29	5 21	5 19	5 16	5 13	5 11	5 8	5 6	5 3	5 0	4 57	4 54	4 51	4 48	4 45	4 42	4 39	4 35
30	5 19	5 17	5 14	5 11	5 9	5 6	5 3	5 0	4 57	4 54	4 51	4 49	4 45	4 42	4 38	4 35	4 31
31	5 18	5 15	5 12	5 9	5 7	5 4	5 1	4 58	4 55	4 52	4 48	4 45	4 42	4 38	4 35	4 31	4 28
32	5 16	5 13	5 10	5 7	5 4	5 1	4 58	4 55	4 52	4 40	4 45	4 42	4 38	4 35	4 31	4 27	4 24

FOR finding the RISING and SETTING of the SUN and STARS.

SEMIDIURNAL OR DURATION ARCS.

North or South LATITUDE of the PLACE, correspondent to N. S. Declination of SUN or STAR.

N.S. Dec. ☉ or *	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°
N.S.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	6 5	6 6	6 6	6 6	6 6	6 6	6 6	6 6	6 7	6 7	6 7	6 7	6 7	6 8	6 8	6 8	6 8
2	6 8	6 8	6 9	6 9	6 9	6 9	6 10	6 10	6 10	6 11	6 11	6 11	6 12	6 12	6 12	6 13	6 13
3	6 11	6 11	6 12	6 12	6 12	6 13	6 13	6 14	6 14	6 15	6 15	6 15	6 16	6 17	6 17	6 18	6 18
4	6 14	6 14	6 15	6 15	6 16	6 16	6 17	6 17	6 18	6 18	6 19	6 20	6 20	6 21	6 22	6 22	6 22
5	6 17	6 17	6 18	6 18	6 19	6 20	6 20	6 21	6 22	6 22	6 23	6 24	6 25	6 25	6 26	6 27	6 27
6	6 19	6 20	6 21	6 22	6 22	6 23	6 24	6 25	6 25	6 26	6 27	6 28	6 29	6 30	6 31	6 32	6 33
7	6 22	6 24	6 24	6 25	6 26	6 26	6 27	6 28	6 29	6 30	6 31	6 32	6 33	6 34	6 36	6 37	6 38
8	6 25	6 26	6 27	6 28	6 29	6 30	6 31	6 32	6 33	6 34	6 35	6 37	6 38	6 39	6 41	6 42	6 43
9	6 28	6 29	6 30	6 31	6 32	6 33	6 35	6 36	6 37	6 38	6 40	6 41	6 42	6 44	6 45	6 47	6 48
10	6 31	6 32	6 33	6 34	6 36	6 37	6 38	6 39	6 41	6 42	6 44	6 45	6 47	6 48	6 50	6 52	6 54
11	6 34	6 35	6 36	6 38	6 39	6 40	6 42	6 43	6 45	6 46	6 48	6 50	6 51	6 53	6 55	6 57	6 59
12	6 37	6 38	6 40	6 41	6 42	6 44	6 45	6 47	6 49	6 50	6 52	6 55	6 56	6 58	7 0	7 2	7 4
13	6 40	6 41	6 43	6 44	6 46	6 48	6 49	6 51	6 53	6 55	6 47	6 59	7 1	7 3	7 5	7 7	7 10
14	6 43	6 44	6 46	6 48	6 49	6 51	6 53	6 55	6 57	6 59	7 1	7 3	7 5	7 8	7 10	7 13	7 15
15	6 46	6 48	6 49	6 51	6 53	6 55	6 57	6 59	7 1	7 3	7 5	7 8	7 10	7 13	7 15	7 18	7 21
16	6 49	6 51	6 53	6 55	6 57	6 59	7 1	7 3	7 5	7 7	7 10	7 12	7 15	7 18	7 21	7 24	7 27
17	6 52	6 54	6 56	6 58	7 0	7 2	7 5	7 7	7 9	7 12	7 14	7 17	7 20	7 23	7 26	7 29	7 33
18	6 55	6 57	7 0	7 2	7 4	7 6	7 9	7 11	7 14	7 16	7 19	7 22	7 25	7 28	7 31	7 35	7 38
19	6 59	7 1	7 3	7 5	7 8	7 10	7 13	7 15	7 18	7 21	7 24	7 27	7 30	7 34	7 37	7 41	7 45
20	7 2	7 4	7 7	7 9	7 12	7 14	7 17	7 20	7 23	7 26	7 29	7 32	7 35	7 39	7 43	7 47	7 51
21	7 5	7 8	7 10	7 13	7 15	7 18	7 21	7 24	7 27	7 30	7 34	7 37	7 41	7 45	7 49	7 53	7 57
22	7 9	7 11	7 13	7 17	7 19	7 22	7 25	7 29	7 32	7 35	7 39	7 43	7 46	7 50	7 55	7 59	8 4
23	7 12	7 15	7 18	7 21	7 24	7 27	7 30	7 33	7 37	7 40	7 44	7 48	7 52	7 56	8 1	8 6	8 11
24	7 16	7 19	7 21	7 25	7 28	7 31	7 34	7 38	7 42	7 45	7 49	7 54	7 58	8 3	8 7	8 12	8 18
25	7 19	7 22	7 25	7 29	7 32	7 35	7 39	7 43	7 47	7 51	7 55	7 59	8 4	8 9	8 14	8 19	8 25
26	7 23	7 26	7 29	7 33	7 36	7 40	7 44	7 48	7 52	7 56	8 1	8 5	8 10	8 15	8 21	8 27	8 33
27	7 27	7 30	7 34	7 37	7 41	7 45	7 49	7 53	7 57	8 2	8 6	8 12	8 17	8 22	8 28	8 34	8 41
28	7 31	7 34	7 38	7 42	7 45	7 49	7 54	7 58	8 3	8 7	8 12	8 18	8 23	8 29	8 35	8 42	8 49
29	7 35	7 38	7 42	7 46	7 50	7 54	7 59	8 4	8 9	8 13	8 19	8 24	8 30	8 37	8 43	8 50	8 58
30	7 39	7 43	7 47	7 51	7 55	8 0	8 5	8 9	8 14	8 20	8 25	8 31	8 38	8 44	8 52	8 59	9 8
31	7 43	7 47	7 51	7 56	8 [illegible]	8 5	8 10	8 15	8 20	8 26	8 32	8 38	8 45	8 52	9 0	9 9	9 18
32	7 47	7 51	7 56	8 1	8 5	8 10	8 16	8 21	8 27	8 33	8 39	8 46	8 53	9 1	9 9	9 19	9 28
S.N.																	
1	6 0	6 0	6 0	6 0	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 58
2	5 57	5 57	5 57	5 56	5 56	5 56	5 56	5 56	5 55	5 55	5 55	5 55	5 55	5 54	5 54	5 54	5 53
3	5 54	5 54	5 54	5 53	5 53	5 53	5 52	5 52	5 52	5 51	5 51	5 51	5 50	5 50	5 49	5 49	5 49
4	5 51	5 51	5 51	5 50	5 50	5 49	5 49	5 48	5 48	5 47	5 47	5 46	5 46	5 45	5 45	5 44	5 44
5	5 49	5 48	5 48	5 47	5 46	5 46	5 45	5 45	5 44	5 44	5 43	5 42	5 42	5 41	5 40	5 39	5 39
6	5 46	5 45	5 44	5 44	5 43	5 43	5 42	5 41	5 40	5 40	5 39	5 38	5 37	5 36	5 35	5 35	5 34
7	5 43	5 42	5 41	5 41	5 40	5 39	5 38	5 37	5 37	5 36	5 35	5 34	5 33	5 32	5 31	5 30	5 29
8	5 40	5 39	5 38	5 37	5 37	5 36	5 35	5 34	5 33	5 32	5 31	5 30	5 28	5 27	5 26	5 25	5 23
9	5 37	5 36	5 35	5 34	5 33	5 32	5 31	5 30	5 29	5 28	5 27	5 25	5 24	5 23	5 21	5 20	5 18
10	5 34	5 33	5 32	5 31	5 30	5 29	5 28	5 26	5 25	5 24	5 22	5 21	5 20	5 18	5 17	5 15	5 13
11	5 31	5 30	5 29	5 28	5 27	5 25	5 24	5 23	5 21	5 20	5 18	5 17	5 15	5 13	5 12	5 10	5 8
12	5 28	5 27	5 26	5 25	5 23	5 22	5 20	5 19	5 17	5 16	5 14	5 12	5 11	5 9	5 7	5 5	5 3
13	5 25	5 24	5 23	5 21	5 20	5 18	5 17	5 15	5 13	5 12	5 10	5 8	5 6	5 4	5 2	5 0	4 57
14	5 22	5 21	5 19	5 18	5 16	5 15	5 13	5 11	5 9	5 7	5 5	5 3	5 1	4 59	4 57	4 54	4 52
15	5 19	5 18	5 16	5 14	5 13	5 11	5 9	5 7	5 5	5 3	5 1	4 59	4 57	4 54	4 52	4 49	4 46
16	5 16	5 15	5 13	5 11	5 9	5 7	5 5	5 3	5 1	4 59	4 57	4 54	4 52	4 49	4 46	4 45	4 41
17	5 13	5 11	5 10	5 8	5 6	5 4	5 1	4 59	4 57	4 55	4 52	4 50	4 47	4 44	4 41	4 38	4 35
18	5 10	5 8	5 6	5 4	5 2	4 59	4 57	4 55	4 53	4 50	4 47	4 45	4 42	4 39	4 36	4 33	4 29
19	5 7	5 5	5 3	5 0	4 58	4 56	4 53	4 51	4 48	4 46	4 43	4 40	4 37	4 34	4 30	4 27	4 23
20	5 4	5 2	4 59	4 57	4 54	4 52	4 49	4 47	4 44	4 41	4 38	4 35	4 32	4 28	4 25	4 21	4 17
21	5 1	4 58	4 56	4 53	4 51	4 48	4 45	4 42	4 39	4 36	4 33	4 30	4 26	4 23	4 19	4 15	4 11
22	4 57	4 55	4 52	4 49	4 47	4 44	4 41	4 38	4 35	4 32	4 28	4 25	4 21	4 17	4 13	4 9	4 4
23	4 54	4 51	4 49	4 46	4 43	4 40	4 37	4 33	4 30	4 27	4 23	4 19	4 15	4 11	4 7	4 3	3 58
24	4 50	4 48	4 45	4 42	4 39	4 35	4 32	4 29	4 25	4 22	4 18	4 14	4 10	4 5	4 1	3 56	3 51
25	4 47	4 44	4 41	4 38	4 34	4 31	4 28	4 24	4 20	4 17	4 13	4 8	4 4	3 59	3 54	3 49	3 44
26	4 43	4 40	4 36	4 34	4 30	4 27	4 23	4 19	4 15	4 11	4 7	4 3	3 58	3 53	3 48	3 42	3 37
27	4 39	4 36	4 33	4 29	4 26	4 22	4 18	4 14	4 10	4 6	4 1	3 57	3 52	3 46	3 41	3 35	3 29
28	4 36	4 32	4 29	4 25	4 21	4 17	4 13	4 9	4 5	4 0	3 55	3 50	3 45	3 40	3 34	3 28	3 21
29	4 32	4 28	4 25	4 21	4 17	4 13	4 8	4 4	3 59	3 54	3 49	3 44	3 38	3 33	3 26	3 20	3 12
30	4 28	4 24	4 20	4 16	4 12	4 8	4 3	3 59	3 54	3 48	3 43	3 37	3 31	3 25	3 18	3 11	3 4
31	4 24	4 20	4 15	4 12	4 7	4 8	3 58	3 53	3 48	3 42	3 37	3 31	3 24	3 17	3 10	3 3	2 54
32	4 19	4 15	4 11	4 7	4 2	3 57	3 52	3 47	3 42	3 36	3 30	3 23	3 17	3 9	3 2	2 53	2 44

FOR

FOR finding the RISING and SETTING of the SUN and STARS.

SEMIDIURNAL or DURATION ARCS.

N.S. Dec. ☉ or Star.	52°	53°	54°	55°	56°	57°	58°	59°	60°	61°	62°	63°	64°	65°	66°
	North or South LATITUDE of the PLACE, correspondent to N. S. Declination of SUN or STAR.														
N.S.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	6 9	6 9	6 9	6 9	6 10	6 10	6 10	6 11	6 11	6 12	6 13	6 13	6 13	6 14	6 14
2	6 14	6 14	6 15	6 15	6 16	6 16	6 17	6 17	6 18	6 19	6 20	6 20	6 21	6 22	6 23
3	6 19	6 19	6 20	6 21	6 22	6 22	6 23	6 24	6 25	6 26	6 27	6 28	6 30	6 31	6 32
4	6 24	6 25	6 26	6 27	6 28	6 29	6 30	6 31	6 32	6 33	6 35	6 36	6 38	6 40	6 41
5	6 29	6 30	6 31	6 32	6 34	6 35	6 36	6 38	6 39	6 41	6 42	6 44	6 46	6 48	6 51
6	6 34	6 36	6 37	6 38	6 40	6 41	6 43	6 44	6 46	6 48	6 50	6 52	6 55	6 57	7 0
7	6 40	6 41	6 43	6 44	6 46	6 48	6 49	6 51	6 53	9 55	6 58	7 1	7 3	7 6	7 10
8	6 45	6 47	6 48	6 50	6 52	6 54	6 56	6 58	7 1	7 3	7 6	7 9	7 12	7 15	7 19
9	6 50	6 52	6 54	6 56	6 58	7 1	7 3	7 5	7 8	7 11	7 14	7 17	7 21	7 25	7 29
10	6 56	6 58	7 0	7 2	7 5	7 7	7 10	7 13	7 16	7 19	7 22	7 26	7 30	7 34	7 39
11	7 1	7 3	7 6	7 8	7 11	7 14	7 17	7 20	7 23	7 27	7 31	7 35	7 39	7 44	7 49
12	7 7	7 9	7 12	7 15	7 18	7 21	7 24	7 27	7 31	7 35	7 39	7 44	7 49	7 54	8 0
13	7 12	7 15	7 18	7 21	7 24	7 28	7 31	7 35	7 39	7 43	7 48	7 53	7 59	8 5	8 11
14	7 18	7 21	7 24	7 28	7 31	7 35	7 39	7 43	7 47	7 52	7 57	8 3	8 9	8 15	8 23
15	7 24	7 27	7 31	7 34	7 39	7 42	7 46	7 51	7 56	8 1	8 6	8 13	8 19	8 27	8 35
16	7 30	7 33	7 37	7 41	7 45	7 49	7 54	7 59	8 4	8 10	8 16	8 23	8 30	8 38	8 48
17	7 36	7 40	7 44	7 48	7 52	7 57	8 2	8 7	8 13	8 19	8 26	8 34	8 42	8 51	9 1
18	7 42	7 46	7 51	7 55	8 0	8 5	8 10	8 16	8 22	8 29	8 37	8 45	8 54	9 4	9 16
19	7 49	7 53	7 58	8 2	8 7	8 13	8 19	8 25	8 32	8 40	8 48	8 57	9 7	9 18	9 32
20	7 55	8 0	8 5	8 10	8 15	8 21	2 28	8 35	8 42	8 50	8 59	9 10	9 21	9 34	9 49
21	8 2	8 7	8 12	8 18	8 24	8 30	8 37	8 45	8 53	9 2	9 12	9 23	9 37	9 51	10 10
22	8 9	8 14	8 20	8 26	8 32	8 39	8 47	8 55	9 4	9 14	9 25	9 38	9 53	10 12	10 35
23	8 16	8 22	8 28	8 34	8 41	8 49	8 57	9 6	9 16	9 27	9 40	9 55	10 13	10 36	11 12
24	8 24	8 30	8 36	8 43	8 51	8 59	9 8	9 18	9 29	9 42	9 57	10 15	10 38	11 13	
25	8 31	8 38	8 45	8 53	9 1	9 10	9 20	9 31	9 44	9 58	10 16	10 39	11 14		
26	8 39	8 47	8 54	9 2	9 11	9 21	9 33	9 45	10 0	10 17	10 40	11 14			
27	8 48	8 56	9 4	9 13	9 23	9 34	9 46	10 1	10 18	10 41	11 14				
28	8 57	9 5	9 14	9 24	9 35	9 48	10 2	10 19	10 42	11 15					
29	9 6	9 14	9 25	9 36	9 49	10 3	10 20	10 42	11 16						
30	9 17	9 26	9 38	9 50	10 4	10 21	10 43	11 16							
31	9 28	9 38	9 51	10 5	10 22	10 44	11 17								
32	9 39	9 52	10 6	10 23	10 44	11 17									
S.N.															
1	5 58	5 58	5 58	5 58	5 58	5 58	5 58	5 57	5 57	5 57	5 57	5 57	5 57	5 56	5 56
2	5 53	5 53	5 53	5 52	5 52	5 52	5 51	5 51	5 50	5 50	5 49	5 49	5 48	5 48	5 47
3	5 48	5 48	5 47	5 47	5 46	5 45	5 45	5 44	5 43	5 43	5 42	5 41	5 40	5 39	5 38
4	5 43	5 42	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 34	5 33	5 32	5 31	5 29
5	5 38	5 37	5 36	5 35	5 34	5 33	5 32	5 31	5 29	5 28	5 27	5 25	5 24	5 22	5 20
6	5 33	5 31	5 30	5 29	5 28	5 27	5 25	5 24	5 22	5 21	5 19	5 17	5 15	5 13	5 11
7	5 27	5 26	5 25	5 23	5 22	5 20	5 19	5 17	5 15	5 13	5 11	5 9	5 7	5 4	5 1
8	5 22	5 21	5 19	5 17	5 16	5 14	5 12	5 10	5 8	5 6	5 3	5 1	4 58	4 55	4 52
9	5 17	5 16	5 13	5 12	5 10	5 8	5 5	5 3	5 1	4 58	4 55	4 53	4 49	4 46	4 42
10	5 11	5 10	5 8	5 5	5 3	5 1	4 59	4 56	4 53	4 50	4 47	4 44	4 40	4 37	4 32
11	5 6	5 4	5 2	4 59	4 57	4 54	4 52	4 49	4 46	4 43	4 39	4 35	4 31	4 27	4 22
12	5 0	4 58	4 56	4 53	4 51	4 48	4 45	4 42	4 38	4 35	4 31	4 27	4 22	4 17	4 12
13	4 55	4 52	4 50	4 47	4 44	4 41	4 38	4 34	4 30	4 26	4 22	4 18	4 13	4 7	4 1
14	4 49	4 47	4 44	4 41	4 37	4 34	4 30	4 27	4 23	4 18	4 13	4 8	4 3	3 56	3 50
15	4 44	4 41	4 37	4 34	4 31	4 27	4 23	4 19	4 14	4 9	4 4	3 59	3 53	3 46	3 39
16	4 38	4 34	4 31	4 27	4 24	4 20	4 15	4 11	4 6	4 1	3 55	3 49	3 42	3 35	3 27
17	4 32	4 28	4 23	4 21	4 17	4 12	4 8	4 3	3 57	3 52	3 45	3 39	3 31	3 23	3 14
18	4 26	4 22	4 18	4 14	4 9	4 5	4 0	3 54	3 48	3 42	3 35	3 28	3 20	3 11	3 0
19	4 19	4 15	4 11	4 7	4 2	3 56	3 51	3 45	3 39	3 32	3 25	3 17	3 8	2 58	2 46
20	4 13	4 9	4 4	3 59	3 54	3 49	3 43	3 36	3 29	3 22	3 14	3 5	2 55	2 43	2 30
21	4 6	4 2	3 57	3 52	3 46	3 40	3 34	3 27	3 19	3 11	3 2	2 52	2 41	2 28	2 12
22	4 0	3 55	3 50	3 44	3 38	3 31	3 24	3 17	3 9	3 0	2 50	2 38	2 25	2 10	1 52
23	3 53	3 47	3 42	3 36	3 29	3 23	3 15	3 6	2 57	2 47	2 36	2 23	2 8	1 50	1 27
24	3 46	3 40	3 34	3 27	3 20	3 13	3 5	2 55	2 45	2 34	2 21	2 7	1 49	1 26	
25	3 38	3 32	3 25	3 18	3 11	3 3	2 53	2 43	2 32	2 20	2 5	1 47	1 25		
26	3 30	3 24	3 17	3 9	3 1	2 52	2 42	2 31	2 18	2 3	1 46	1 23			
27	3 22	3 15	3 8	2 59	2 50	2 40	2 29	2 16	2 2	1 45	1 22				
28	3 14	3 6	2 58	2 49	2 38	2 28	2 15	2 1	1 43	1 21					
29	3 5	2 56	2 47	2 37	2 26	2 14	2 0	1 42	1 21						
30	2 55	2 46	2 36	2 25	2 13	1 58	1 41	1 20							
31	2 45	2 35	2 24	2 12	1 57	1 41	1 19								
32	2 34	2 23	2 11	1 57	1 40	1 18									

For finding the Variation of the Compass.

Amplitude of Rising and Setting, from East and West.

N. S.	North or South Latitude of the Place, correspondent to N. S. Declination of Sun or Star.														
Declin. Sun or Star.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°
N. S.	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Amplitude Northerly from E. or W. Lat. N. but Southerly Lat. S.															
1	1 0	1 1	1 2	1 2	1 3	1 4	1 4	1 5	1 6	1 7	1 7	1 8	1 9	1 10	1 11
2	2 0	2 1	2 2	2 2	2 3	2 4	2 5	2 6	2 6	2 7	2 8	2 9	2 10	2 12	2 13
3	3 0	3 1	3 2	3 2	3 3	3 4	3 5	3 6	3 7	3 8	3 9	3 10	3 12	3 13	3 15
4	4 0	4 1	4 2	4 3	4 4	4 5	4 6	4 7	4 8	4 9	4 11	4 12	4 14	4 15	4 17
5	5 0	5 1	5 2	5 3	5 4	5 5	5 6	5 8	5 9	5 10	5 12	5 14	5 15	5 17	5 19
6	6 1	6 1	6 2	6 3	6 4	6 5	6 7	6 8	6 10	6 11	6 13	6 15	6 17	6 19	6 21
7	7 1	7 1	7 2	7 3	7 4	7 6	7 7	7 9	7 10	7 12	7 14	7 16	7 19	7 21	7 24
8	8 1	8 1	8 2	8 3	8 5	8 6	8 8	8 9	8 11	8 13	8 15	8 18	8 20	8 23	8 26
9	9 1	9 1	9 2	9 4	9 5	9 6	9 8	9 10	9 12	9 14	9 16	9 19	9 22	9 25	9 28
10	10 1	10 1	10 2	10 4	10 5	10 7	10 8	10 10	10 13	10 15	10 18	10 20	10 23	10 27	10 30
11	11 1	11 1	11 2	11 4	11 5	11 7	11 9	11 11	11 13	11 16	11 19	11 22	11 25	11 28	11 32
12	12 1	12 1	12 2	12 4	12 6	12 7	12 9	12 12	12 14	12 17	12 20	12 23	12 27	12 30	12 34
13	13 1	13 2	13 3	13 4	13 6	13 8	13 10	13 12	13 15	13 18	13 21	13 25	13 29	13 32	13 37
14	14 1	14 2	14 3	14 4	14 6	14 8	14 10	14 13	14 16	14 19	14 22	14 26	14 30	14 34	14 39
15	15 1	15 2	15 3	15 5	15 6	15 8	15 11	15 14	15 17	15 20	15 24	15 28	15 32	15 36	15 42
16	16 1	16 2	16 3	16 5	16 7	16 9	16 11	16 14	16 17	16 21	16 25	16 29	16 34	16 39	10 44
17	17 1	17 2	17 3	17 5	17 7	17 9	17 12	17 15	17 18	17 22	17 26	17 30	17 35	17 41	17 46
18	18 1	18 2	18 3	18 5	18 7	18 10	18 13	18 16	18 19	18 23	18 27	18 32	18 37	18 43	18 48
19	19 1	19 2	19 3	19 5	19 7	19 10	19 13	19 16	19 20	19 24	19 28	19 34	19 39	19 45	19 51
20	20 1	20 2	20 4	20 6	20 8	20 10	20 14	20 17	20 21	20 25	20 30	20 35	20 41	20 47	20 53
21	21 1	21 2	21 4	21 6	21 8	21 11	21 14	21 18	21 22	21 26	21 31	21 37	21 43	21 49	21 56
22	22 1	22 2	22 4	22 6	22 8	22 11	22 15	22 19	22 23	22 28	22 33	22 38	22 45	22 52	22 59
23	23 1	23 2	23 4	23 6	23 8	23 12	23 15	23 19	23 24	23 29	23 34	23 40	23 47	23 54	24 1
24	24 1	24 2	24 4	24 6	24 9	24 12	24 16	24 20	24 25	24 30	24 36	24 42	24 49	24 56	25 4
25	25 1	25 2	25 4	25 6	25 9	25 13	25 16	25 21	25 26	25 31	25 37	25 43	25 51	25 58	26 6
26	26 1	26 2	26 4	26 7	26 10	26 13	26 17	26 22	26 27	26 32	26 38	26 45	26 53	27 0	27 9
27	27 1	27 2	27 4	27 7	27 10	27 13	27 17	27 22	27 28	27 34	27 40	27 47	27 55	28 3	28 12
28	28 1	28 2	28 4	28 7	28 10	28 14	28 18	28 23	28 29	28 35	28 41	28 49	28 57	29 5	29 15
29	29 1	29 2	29 4	29 7	29 11	29 14	29 19	29 24	29 30	29 36	29 43	29 51	29 59	30 8	30 18
30	30 1	30 2	30 5	30 7	30 11	30 15	30 19	30 25	30 31	30 38	30 44	30 52	31 1	31 10	31 20
31	31 1	31 3	31 5	31 7	31 11	31 15	31 20	31 26	31 32	31 39	31 46	31 54	32 3	32 13	32 23
32	32 1	32 3	32 5	32 7	32 12	32 16	32 21	32 26	32 33	32 40	32 48	32 56	33 6	33 16	33 27
S. N.															
Amplitude Southerly from E. or W. Lat. N. but Northerly Lat. S.															
1	0 59	0 59	0 58	0 58	0 57	0 57	0 56	0 56	0 56	0 55	0 55	0 54	0 54	0 53	0 53
2	1 59	1 59	1 58	1 58	1 58	1 57	1 57	1 57	1 56	1 56	1 56	1 56	1 56	1 56	1 56
3	2 59	2 59	2 58	2 58	2 58	2 58	2 57	2 57	2 57	2 57	2 57	2 57	2 57	2 57	2 58
4	3 59	3 59	3 59	3 58	3 58	3 58	3 58	3 58	3 58	3 58	3 58	3 58	3 59	3 59	4 0
5	4 59	4 59	4 59	4 58	4 58	4 58	4 58	4 58	4 59	4 59	4 59	5 0	5 1	5 1	5 2
6	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	5 59	6 0	6 1	6 1	6 2	6 3	6 4
7	6 59	6 59	6 59	6 59	6 59	6 59	6 59	6 59	7 0	7 1	7 2	7 3	7 4	7 5	7 6
8	7 59	7 59	7 59	7 59	7 59	8 0	8 0	8 0	8 1	8 2	8 3	8 4	8 5	8 7	8 8
9	8 59	8 59	8 59	8 59	8 59	9 0	9 0	9 1	9 2	9 3	9 4	9 5	9 7	9 8	9 10
10	9 59	9 59	9 59	9 59	9 59	10 0	10 0	10 1	10 2	10 4	10 5	10 7	10 8	10 10	10 13
11	10 59	10 59	10 59	10 59	11 0	11 0	11 1	11 2	11 3	11 4	11 6	11 8	11 10	11 12	11 15
12	11 59	11 59	11 59	11 59	12 0	12 1	12 1	12 3	12 4	12 5	12 7	12 9	12 12	12 14	12 17
13	12 59	12 59	12 59	13 0	13 0	13 1	13 2	13 3	13 5	13 6	13 8	13 11	13 13	13 16	13 19
14	13 59	13 59	13 59	14 0	14 1	14 1	14 2	14 4	14 6	14 7	14 10	14 12	14 15	14 18	14 21
15	15 0	15 0	15 0	15 0	15 1	15 2	15 3	15 4	15 6	15 8	15 11	15 13	15 17	15 20	15 24
16	16 0	16 0	16 0	16 0	16 1	16 2	16 3	16 5	16 7	16 9	16 12	16 15	16 18	16 22	16 26
17	17 0	17 0	17 0	17 0	17 1	17 2	17 4	17 6	17 8	17 10	17 13	17 16	17 20	17 24	17 28
18	18 0	18 0	18 0	18 0	18 2	18 3	18 4	18 6	18 9	18 11	18 14	18 18	18 22	18 26	18 30
19	19 0	19 0	19 0	19 0	19 2	19 3	19 5	19 7	19 9	19 12	19 15	19 19	19 23	19 28	19 33
20	20 0	20 0	20 0	20 0	20 2	20 3	20 5	20 8	20 10	20 13	20 17	20 21	20 25	20 30	20 35
21	21 0	21 0	21 0	21 1	21 2	21 4	21 6	21 8	21 11	21 14	21 18	21 22	21 27	21 32	21 38
22	22 0	22 0	22 0	22 1	22 2	22 4	22 6	22 9	22 12	22 15	22 19	22 24	22 29	22 34	22 40
23	23 0	23 0	23 0	23 1	23 2	23 4	23 7	23 9	23 13	23 16	23 21	23 25	23 30	23 36	23 42
24	24 0	24 0	24 0	24 1	24 3	24 5	24 7	24 10	24 13	24 17	24 22	24 27	24 32	24 38	24 45
25	25 0	25 0	25 0	25 1	25 3	25 5	25 8	25 11	25 14	25 18	25 23	25 28	25 34	25 40	25 47
26	26 0	26 0	26 0	26 2	26 3	26 5	26 8	26 11	26 15	26 20	26 24	26 30	26 36	26 43	26 50
27	27 0	27 0	27 0	27 2	27 4	27 6	27 9	27 12	27 16	27 21	27 26	27 32	27 38	27 45	27 53
28	28 0	28 0	28 1	28 2	28 4	28 6	28 9	28 13	28 17	28 22	28 27	28 33	28 40	28 47	28 55
29	29 0	29 0	29 1	29 2	29 4	29 7	29 10	29 14	29 18	29 23	29 29	29 35	29 42	29 50	29 58
30	30 0	30 0	30 1	30 2	30 4	30 7	30 10	30 14	30 19	30 24	30 30	30 37	30 44	30 52	31 0
31	31 0	31 0	31 1	31 2	31 4	31 8	31 11	31 15	31 20	31 26	31 32	31 38	31 46	31 54	32 3
32	32 0	32 0	32 1	32 3	32 4	32 8	32 11	32 16	32 21	32 27	32 33	12 40	32 48	32 57	33 6

For finding the VARIATION of the COMPASS.

AMPLITUDE of RISING and SETTING, from EAST and WEST.

N. S. — North or South LATITUDE of the PLACE, correspondent to N. S. Declination of SUN or STAR.

Amplitude Northerly from E. or W. Lat. N. but Southerly Lat. S.

Declin. Sun or Star. N.S.	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1°	1 12	1 13	1 14	1 15	1 16	1 17	1 18	1 19	1 20	1 21	1 22	1 24	1 25	1 26	1 28
2	2 14	2 15	2 17	2 18	2 19	2 21	2 22	2 24	2 26	2 27	2 29	2 31	2 33	2 35	3 37
3	3 16	3 18	3 20	3 21	3 23	3 25	3 27	3 29	3 31	3 24	3 36	3 38	3 41	3 44	3 46
4	4 19	4 21	4 23	4 25	4 27	4 29	4 32	4 34	4 37	4 40	4 43	4 46	4 49	4 52	4 56
5	5 21	5 23	5 26	5 28	5 31	5 34	5 37	5 40	5 43	5 46	5 50	5 54	5 57	6 1	6 5
6	6 24	6 26	6 29	6 32	6 35	6 38	6 42	6 45	6 48	6 52	6 56	7 1	7 5	7 10	7 15
7	7 26	7 29	7 32	7 36	7 39	7 42	7 46	7 50	7 54	7 59	8 3	8 8	8 13	8 18	8 24
8	8 29	8 32	8 35	8 39	8 43	8 47	8 51	8 56	9 0	9 5	9 10	9 16	9 22	9 27	9 34
9	9 31	9 35	9 38	9 43	9 47	9 51	9 56	10 1	10 6	10 12	10 17	10 23	10 30	10 36	10 43
10	10 34	10 38	10 42	10 46	10 51	10 56	11 1	11 6	11 12	11 18	11 24	11 31	11 38	11 45	11 53
11	11 36	11 40	11 45	11 50	11 55	12 0	12 6	12 12	12 18	12 24	12 31	12 38	12 46	12 54	13 2
12	12 38	12 43	12 48	12 53	12 59	13 5	13 11	13 17	13 24	13 31	13 38	13 46	13 55	14 3	14 12
13	13 41	13 46	13 52	13 57	14 3	14 9	14 16	14 23	14 30	14 38	14 46	14 54	15 3	15 12	15 22
14	14 44	14 49	14 55	15 1	15 7	15 14	15 21	15 28	15 36	15 44	15 53	16 2	16 12	16 22	16 32
15	15 47	15 52	15 58	16 5	16 11	16 18	16 26	16 34	16 42	16 51	17 0	17 10	17 20	17 31	17 43
16	16 49	16 55	17 2	17 8	17 15	17 23	17 32	17 40	17 49	17 58	18 8	18 18	18 29	18 41	18 53
17	17 52	17 58	18 5	18 12	18 20	18 28	18 36	18 45	18 55	19 5	19 16	19 27	19 38	19 50	20 4
18	18 55	19 2	19 9	19 16	19 24	19 33	19 42	19 51	20 1	20 12	20 23	20 35	20 47	21 0	21 14
19	19 58	20 5	20 12	20 20	20 29	20 38	20 47	20 57	21 8	21 19	21 31	21 44	21 57	22 11	22 25
20	21 0	21 8	21 16	21 24	21 33	21 43	21 53	22 3	22 15	22 36	22 39	22 52	23 6	23 21	23 36
21	22 3	22 11	22 19	22 28	22 38	22 48	22 58	23 9	23 21	23 34	23 47	24 1	24 16	24 31	24 47
22	23 6	23 14	23 23	23 32	23 42	23 53	24 4	24 16	24 29	24 42	24 55	25 10	25 25	25 41	25 58
23	24 9	24 18	24 27	24 37	24 47	24 58	25 10	25 22	25 35	25 49	26 3	26 19	26 35	26 52	27 10
24	25 12	25 21	25 31	25 41	25 52	26 3	26 16	26 29	26 41	26 56	27 12	27 28	27 45	28 3	28 22
25	26 15	26 25	26 35	26 46	26 57	27 9	27 22	27 35	27 49	28 5	28 21	28 37	28 55	29 14	29 34
26	27 18	27 28	27 39	27 50	28 2	28 14	28 28	28 42	28 57	29 13	29 29	29 47	30 6	30 25	30 46
27	28 21	28 32	28 43	28 54	29 7	29 20	29 34	29 49	30 4	30 21	30 38	30 57	31 16	31 37	31 59
28	29 25	29 35	29 47	29 59	30 12	30 26	30 40	30 56	31 12	31 29	31 48	32 7	32 27	32 49	33 12
29	30 29	30 39	30 51	31 4	31 17	31 32	31 47	32 3	32 20	32 38	32 57	33 17	33 39	34 1	34 25
30	31 32	31 43	31 55	32 9	32 23	32 38	32 53	33 10	33 28	33 47	34 7	34 28	34 50	35 14	35 39
31	32 35	32 47	33 0	33 14	33 28	33 44	34 0	34 18	34 37	34 56	35 17	35 39	36 2	36 27	36 52
32	33 38	33 51	34 4	34 18	34 34	34 50	35 7	35 26	35 45	36 5	36 27	36 50	37 14	37 40	38 7

Amplitude Southerly from E. or W. Lat. S. but Northerly Lat. N.

S. N.	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°
1°	0 53	0 53	0 53	0 53	0 52	0 52	0 52	0 52	0 52	0 51	0 51	0 51	0 51	0 51	0 51
2	1 56	1 56	1 56	1 56	1 56	1 57	1 57	1 57	1 57	1 58	1 58	1 58	1 59	1 59	2 0
3	2 58	2 59	2 59	3 0	3 0	3 1	3 1	3 2	3 3	3 4	3 5	3 6	3 7	3 8	3 9
4	4 0	4 1	4 2	4 3	4 4	4 5	4 6	4 7	4 8	4 10	4 11	4 13	4 13	4 15	4 17
5	5 3	5 4	5 5	5 6	5 8	5 9	5 11	5 12	5 14	5 16	5 18	5 21	5 23	5 25	5 28
6	6 5	6 7	6 8	6 10	6 11	6 13	6 15	6 17	6 19	6 21	6 23	6 26	6 28	6 31	6 34
7	7 8	7 9	7 11	7 13	7 15	7 18	7 20	7 23	7 26	7 29	7 32	7 35	7 39	7 43	7 47
8	8 10	8 12	8 14	8 17	8 19	8 22	8 25	8 28	8 31	8 35	8 39	8 43	8 47	8 51	8 55
9	9 13	9 15	9 17	9 20	9 23	9 26	9 30	9 33	9 37	9 41	9 45	9 50	9 55	10 0	10 6
10	10 15	10 18	10 21	10 24	10 27	10 31	10 35	10 39	10 43	10 48	10 53	10 58	11 3	11 9	11 15
11	11 18	11 21	11 24	11 27	11 31	11 35	11 39	11 44	11 49	11 54	11 59	12 5	12 12	12 18	12 25
12	12 20	12 24	12 27	12 31	12 35	12 39	12 44	12 49	12 55	13 0	13 6	13 13	13 20	13 27	13 34
13	13 23	13 26	13 30	13 34	13 39	13 44	13 49	13 55	14 1	14 7	14 14	14 21	14 28	14 36	14 44
14	14 25	14 29	14 33	14 38	14 43	14 48	14 54	15 0	15 6	15 14	15 21	15 28	15 36	15 45	15 54
15	15 27	15 32	15 37	15 42	15 47	15 53	15 59	16 6	16 13	16 20	16 28	16 36	16 45	16 54	17 4
16	16 30	16 35	16 40	16 45	16 51	16 57	17 4	17 11	17 19	17 27	17 35	17 44	17 53	18 3	18 14
17	17 33	17 38	17 43	17 49	17 55	18 2	18 9	18 17	18 25	18 33	18 42	18 52	19 2	19 13	19 24
18	18 35	18 41	18 47	18 53	19 0	19 7	19 14	19 25	19 31	19 40	19 50	20 0	20 11	20 23	20 35
19	19 38	19 44	19 50	19 57	20 4	20 12	20 20	20 28	20 37	20 47	20 57	21 8	21 20	21 32	21 45
20	20 41	20 47	20 54	21 1	21 8	21 16	21 25	21 34	21 44	21 54	22 5	22 17	22 29	22 42	22 56
21	21 44	21 50	21 57	22 4	22 12	22 21	22 30	22 40	22 50	23 1	23 13	23 25	23 38	23 52	24 6
22	22 46	22 53	23 1	23 8	23 17	23 26	23 36	23 46	23 57	24 9	24 21	24 34	24 48	25 2	25 17
23	23 49	23 56	24 4	24 12	24 21	24 31	24 41	24 52	25 4	25 16	25 29	25 42	25 57	26 12	26 28
24	24 52	25 0	25 8	25 17	25 26	25 36	25 47	25 58	26 10	26 23	26 37	26 52	27 7	27 23	27 40
25	25 55	26 3	26 12	26 21	26 31	26 41	26 52	27 4	27 17	27 31	27 45	28 0	28 16	28 33	28 51
26	26 58	27 6	27 15	27 25	27 36	27 47	27 58	28 11	28 25	28 39	28 54	29 10	29 26	29 44	30 3
27	28 1	28 10	28 19	28 29	28 40	28 52	29 4	29 17	29 32	29 46	30 2	30 19	30 37	30 56	31 16
28	29 4	29 13	29 23	29 34	29 45	29 57	30 10	30 24	30 39	30 54	31 11	31 29	31 47	32 7	32 28
29	30 7	30 17	30 27	30 38	30 50	31 3	31 17	31 31	31 46	32 2	32 21	32 39	32 58	33 19	33 40
30	31 10	31 20	31 31	31 43	31 55	32 8	32 23	32 38	32 54	33 11	33 30	33 49	34 9	34 31	34 54
31	32 13	32 24	32 35	32 47	33 0	33 14	33 29	33 45	34 2	34 20	34 39	34 59	35 20	35 43	36 7
32	33 16	33 27	33 39	33 52	34 6	34 20	34 36	34 52	35 10	35 29	35 49	36 10	36 32	36 55	37 20

For finding the Variation of the Compass.

AMPLITUDE of RISING and SETTING, from East and West.

N. S. — North or South Latitude of the Place, correspondent to N. S. Declination of Sun or Star.

Amplitude Northerly from E. or W. Lat. N. but Southerly Lat. S.

Declin. Sun or Star.	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°
N. S.	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1°	1 29	1 31	1 32	1 34	1 36	1 38	1 39	1 41	1 43	1 45	1 47	1 50	1 52	1 54	1 57
2	2 39	2 42	2 44	2 46	2 49	2 52	2 54	2 57	3 0	3 4	3 7	3 10	3 14	3 18	3 22
3	3 49	3 52	3 55	3 59	4 2	4 6	4 10	4 14	4 18	4 22	4 26	4 31	4 36	4 41	4 47
4	4 59	5 3	5 7	5 11	5 16	5 20	5 25	5 30	5 35	5 40	5 46	5 52	5 58	6 5	6 12
5	6 9	6 14	6 19	6 24	6 29	6 34	6 40	6 46	6 52	6 59	7 6	7 13	7 21	7 29	7 37
6	7 20	7 25	7 30	7 36	7 42	7 49	7 56	8 3	8 10	8 18	8 26	8 34	8 43	8 53	9 3
7	8 30	8 36	8 42	8 49	8 56	9 3	9 11	9 19	9 28	9 37	9 46	9 56	10 6	10 16	10 28
8	9 40	9 47	9 54	10 2	10 10	10 18	10 27	10 36	10 45	10 55	11 6	11 17	11 29	11 41	11 54
9	10 50	10 58	11 6	11 15	11 24	11 33	11 42	11 53	12 3	12 14	12 26	12 39	12 52	13 5	13 20
10	12 1	12 9	12 18	12 28	12 37	12 48	12 58	13 9	13 21	13 34	13 47	14 0	14 15	14 30	14 46
11	13 11	13 21	13 31	13 41	13 51	14 2	14 14	14 27	14 40	14 53	15 8	15 23	15 38	15 55	16 13
12	14 22	14 32	14 43	14 54	15 5	15 18	15 30	15 44	15 58	16 13	16 28	16 45	17 2	17 20	17 40
13	15 33	15 44	15 55	16 7	16 20	16 33	16 47	17 1	17 17	17 33	17 50	18 8	18 26	18 46	19 7
14	16 44	16 55	17 8	17 21	17 34	17 48	18 3	18 19	18 36	18 53	19 11	19 31	19 51	20 12	20 34
15	17 55	18 7	18 20	18 34	18 49	19 4	19 20	19 37	19 55	20 14	20 33	20 54	21 16	21 38	22 3
16	19 6	19 19	19 33	19 48	20 4	20 20	20 37	20 55	21 14	21 34	21 55	22 17	22 41	23 5	23 31
17	20 17	20 31	20 46	21 2	21 19	21 36	21 54	22 14	22 34	22 55	23 18	23 42	24 6	24 33	25 1
18	21 28	21 44	22 0	22 16	22 34	22 53	23 12	23 32	23 54	24 17	24 41	25 6	25 32	26 1	26 31
19	22 40	22 56	23 13	23 31	23 50	24 9	24 30	24 52	25 15	25 39	26 4	26 31	26 59	27 29	28 1
20	23 52	24 9	24 27	24 46	25 6	25 26	25 48	26 11	26 36	27 1	27 28	27 57	28 27	28 59	29 32
21	25 4	25 22	25 41	26 1	26 22	26 44	27 7	27 31	27 57	28 24	28 53	29 23	29 55	30 29	31 4
22	26 16	26 35	26 55	27 16	27 38	28 1	28 26	28 52	29 19	29 47	30 18	30 50	31 24	31 59	32 37
23	27 29	27 49	28 10	28 32	28 55	29 19	29 45	30 12	30 41	31 11	31 43	32 17	32 53	33 31	34 11
24	28 42	29 3	29 25	29 48	30 12	30 38	31 5	31 34	32 4	32 36	33 10	33 46	34 24	35 3	35 46
25	29 55	30 17	30 40	31 4	31 30	31 57	31 25	32 56	33 28	34 1	34 37	35 15	35 55	36 37	37 22
26	31 8	31 31	31 55	32 21	32 48	33 16	33 40	34 18	34 52	35 27	36 5	36 45	37 28	38 12	39 0
27	32 22	32 46	33 11	33 38	34 6	34 36	35 8	35 41	36 17	36 54	37 34	38 16	39 1	39 48	40 39
28	33 36	34 1	34 28	34 56	35 26	35 57	36 30	37 5	37 42	38 22	39 4	39 48	40 35	41 26	42 19
29	34 50	35 16	35 44	36 14	36 45	37 18	37 53	38 30	39 9	39 51	40 35	41 22	42 11	43 5	44 2
30	36 5	36 32	37 2	37 33	38 6	38 40	39 17	39 56	40 37	41 20	42 7	42 57	43 49	44 45	45 46
31	37 20	37 49	38 20	38 52	39 26	40 3	40 41	41 22	42 5	42 51	43 40	44 33	45 28	46 28	47 32
32	38 36	39 6	39 38	40 12	40 48	41 26	42 -	42 50	43 35	44 24	45 16	46 11	47 10	48 13	49 21

Amplitude Southerly from E. or W. Lat. N. but Northerly Lat. S.

N. S.	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°
1°	0 51	0 51	0 51	0 51	0 51	0 51	0 51	0 51	0 51	0 52	0 52	0 52	0 52	0 52	0 53
2	2 1	2 2	2 2	2 3	2 4	2 5	2 6	2 7	2 8	2 10	2 11	2 13	2 14	2 16	2 18
3	3 11	3 12	3 14	3 15	3 17	3 19	3 21	3 23	3 26	3 28	3 31	3 34	3 37	3 40	3 43
4	4 21	4 23	4 25	4 28	4 30	4 33	4 36	4 39	4 43	4 46	4 50	4 54	4 58	5 3	5 7
5	5 31	5 34	5 37	5 40	5 44	5 48	5 52	5 56	6 0	6 5	6 10	6 15	6 21	6 27	6 33
6	6 41	6 45	6 49	6 53	6 57	7 2	7 7	7 12	7 18	7 24	7 30	7 30	7 43	7 50	7 58
7	7 51	7 56	8 0	8 5	8 11	8 16	8 22	8 28	8 35	8 42	8 49	8 57	9 5	9 14	9 23
8	9 1	9 7	9 12	9 18	9 24	9 31	9 38	9 45	9 53	10 1	10 9	10 18	10 28	10 38	10 48
9	10 12	10 18	10 24	10 31	10 38	10 45	10 53	11 1	11 10	11 20	11 29	11 40	11 50	12 2	12 14
10	11 22	11 29	11 36	11 43	11 51	12 0	12 9	12 18	12 28	12 39	12 49	13 1	13 13	13 26	13 40
11	12 32	12 40	12 48	12 56	13 5	13 14	13 24	13 35	13 46	13 58	14 10	14 23	14 36	14 51	15 6
12	13 42	13 51	14 0	14 9	14 19	14 29	14 41	14 52	15 4	15 17	15 30	15 45	16 0	16 16	16 33
13	14 53	15 2	15 12	15 22	15 33	15 44	15 56	16 9	16 22	16 36	16 51	17 7	17 23	17 41	17 59
14	16 4	16 14	16 24	16 35	16 47	17 0	17 13	17 27	17 41	17 56	18 12	18 29	18 47	19 6	19 26
15	17 14	17 25	17 37	17 49	18 2	18 15	18 29	18 44	19 0	19 16	19 34	19 52	20 12	20 32	20 54
16	18 25	18 37	18 49	19 2	19 16	19 30	19 46	20 2	20 19	20 36	20 55	21 15	21 36	21 58	22 22
17	19 36	19 49	20 2	20 16	20 31	20 46	21 2	21 20	21 38	21 57	22 17	22 39	23 1	23 25	23 50
18	20 47	21 1	21 15	21 30	21 46	22 2	22 20	22 38	22 57	23 18	23 41	24 3	24 27	24 52	25 19
19	21 59	22 13	22 28	22 44	23 1	23 18	23 37	23 57	24 17	24 39	25 3	25 27	25 53	26 20	26 49
20	23 10	23 25	23 41	23 58	24 16	24 35	24 55	25 16	25 38	26 1	26 26	26 52	27 19	27 48	28 19
21	24 22	24 38	24 55	25 13	25 32	25 52	26 13	26 35	26 58	27 23	27 49	28 17	28 46	29 17	29 50
22	25 34	25 51	26 9	26 28	26 48	27 9	27 31	27 55	28 20	28 46	29 14	29 43	30 14	30 47	31 22
23	26 46	27 4	27 23	27 43	28 4	28 26	28 50	29 15	29 41	30 9	30 38	31 9	31 42	32 17	32 54
24	27 58	28 17	28 37	28 58	29 20	29 44	30 9	30 35	31 3	31 33	31 4	32 37	33 12	33 49	34 28
25	29 10	29 30	29 52	30 14	30 38	31 3	31 20	31 56	32 26	32 57	33 30	34 5	34 42	35 21	36 3
26	30 23	30 44	31 7	31 30	31 55	32 21	32 49	33 18	33 49	34 22	34 57	35 33	36 13	36 54	37 38
27	31 36	31 58	32 22	32 47	33 13	33 40	34 9	34 40	35 13	35 47	36 24	37 3	37 44	38 28	39 15
28	32 50	33 13	33 37	34 3	34 31	35 0	35 31	36 3	36 37	37 14	37 53	38 34	39 17	40 4	40 53
29	34 3	34 28	34 54	35 21	35 50	36 20	36 52	37 26	38 3	38 41	39 22	40 5	40 52	41 41	42 33
30	35 18	35 43	36 10	36 39	37 8	37 41	38 15	38 51	39 29	40 10	40 53	41 38	42 27	43 19	44 15
31	36 32	36 59	37 27	37 57	38 29	39 2	39 38	40 16	40 56	41 39	42 24	43 13	44 4	45 0	45 59
32	37 47	38 15	38 45	39 16	39 49	40 25	41 2	41 42	42 24	43 9	43 57	44 48	45 43	46 42	47 45

FOR finding the VARIATION of the COMPASS.

AMPLITUDE of RISING and SETTING, from EAST and WEST.

N.S. — North or South LATITUDE of the PLACE, correspondent to N. S. Declination of SUN or STAR.

Amplitude Northerly from E. or W. Lat. N. but Southerly Lat. S.

Dec. ☉ or ✱. N.S.	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1°	2 0	2 2	2 5	2 8	2 12	2 15	2 18	2 22	2 26	2 30	2 35	2 40	2 45	2 50	2 56
2	3 26	3 30	3 35	3 40	3 45	3 50	3 56	4 2	4 8	4 15	4 22	4 30	4 38	4 47	4 56
3	4 53	4 59	5 5	5 11	5 18	5 26	5 34	5 42	5 51	6 0	6 10	6 20	6 32	6 44	6 56
4	6 20	6 27	6 35	6 43	6 52	7 2	7 12	7 22	7 33	7 45	7 58	8 11	8 26	8 41	8 57
5	7 46	7 55	8 5	8 15	8 26	8 38	8 50	9 3	9 16	9 31	9 46	10 2	10 20	10 39	10 59
6	9 13	9 24	9 35	9 47	10 0	10 14	10 28	10 43	10 59	11 16	11 33	11 54	12 15	12 37	13 1
7	10 40	10 52	11 6	11 20	11 35	11 50	12 7	12 24	12 43	13 3	13 24	13 46	14 11	14 36	15 4
8	12 7	12 22	12 37	12 52	13 9	13 27	13 46	14 6	14 27	14 50	15 14	15 39	16 7	16 36	17 8
9	13 35	13 51	14 8	14 26	14 45	15 5	15 26	15 48	16 12	16 37	17 4	17 33	18 4	18 37	19 12
10	15 3	15 21	15 39	15 59	16 20	16 42	17 6	17 31	17 57	18 26	18 56	19 28	20 2	20 39	21 19
11	16 31	16 51	17 11	17 33	17 56	18 21	18 47	19 14	19 43	20 14	20 48	21 22	22 1	22 42	23 26
12	18 0	18 21	18 44	19 8	19 33	19 59	20 28	20 58	21 30	22 4	22 41	23 20	24 2	24 47	25 36
13	19 29	19 52	20 16	20 42	21 10	21 39	22 10	22 43	23 18	23 55	24 35	25 18	26 4	26 53	27 47
14	20 58	21 23	21 50	22 18	22 48	23 19	23 53	24 29	25 7	25 47	26 31	27 18	28 8	29 2	30 0
15	22 28	22 55	23 24	23 54	24 26	25 1	25 37	26 16	26 57	27 41	28 28	29 19	30 13	31 12	32 16
16	23 59	24 28	24 58	25 31	26 6	26 43	27 22	28 4	28 47	29 36	30 27	31 22	32 21	33 25	34 34
17	25 30	26 1	26 34	27 9	27 46	28 26	29 8	29 53	30 41	31 32	32 27	33 27	34 31	35 41	36 56
18	27 2	27 35	28 10	28 48	29 28	30 10	30 55	31 43	32 35	33 31	34 30	35 34	36 34	37 59	39 22
19	28 35	29 10	29 48	30 28	31 10	31 56	32 44	33 36	34 31	35 31	36 35	37 45	39 0	40 22	41 51
20	30 8	30 46	31 26	32 8	32 54	33 43	34 34	35 30	36 29	37 34	38 43	39 58	41 19	42 49	44 27
21	31 42	32 22	33 5	33 51	34 39	35 31	36 27	37 26	38 30	39 39	40 54	42 15	43 43	45 20	47 8
22	33 18	34 0	34 46	35 34	36 26	37 21	38 21	39 24	40 33	41 48	43 8	44 36	46 12	47 58	49 56
23	34 54	35 39	36 28	37 19	38 14	39 14	40 17	41 25	42 39	43 59	45 27	47 2	48 47	50 44	52 54
24	36 31	37 20	38 11	39 6	40 5	41 8	42 16	43 29	44 49	46 16	47 50	49 34	51 29	53 38	56 4
25	38 10	39 2	39 56	40 55	41 57	43 5	44 18	45 37	47 3	48 36	50 19	52 13	54 20	56 44	59 28
26	39 51	40 45	41 43	42 46	43 53	45 5	46 23	47 48	49 21	51 2	52 55	55 1	57 22	60 4	63 14
27	41 33	42 30	43 32	44 39	45 50	47 8	48 32	50 4	51 44	53 36	55 40	57 59	60 39	63 46	67 32
28	43 16	44 18	45 24	46 35	47 52	49 15	50 46	52 25	54 15	56 17	58 35	61 12	64 16	67 59	72 46
29	45 2	46 8	47 18	48 34	49 56	51 26	53 4	54 53	56 53	59 9	61 44	64 45	68 24	73 6	80 20
30	46 50	48 0	49 15	50 37	52 5	53 43	55 30	57 29	59 43	62 16	65 14	68 49	73 26	80 31	
31	48 41	49 56	51 16	52 44	54 20	56 5	58 3	60 15	62 45	65 41	69 12	73 45	80 42		
32	50 35	51 54	53 21	54 56	56 40	58 36	60 46	63 14	66 7	69 35	74 2	80 53			

Amplitude Southerly from E. or W. Lat. N. but Northerly Lat. S.

S.N.	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°
1°	0 53	0 53	0 54	0 55	0 55	0 56	0 56	0 57	0 58	0 59	1 0	1 1	1 2	1 3	1 4
2	2 20	2 22	2 24	2 26	2 28	2 31	2 34	2 37	2 40	2 43	2 47	2 51	2 55	3 0	3 5
3	3 46	3 50	3 54	3 58	4 2	4 6	4 11	4 17	4 22	4 28	4 34	4 41	4 49	4 56	5 4
4	5 12	5 18	5 23	5 29	5 35	5 42	5 49	5 57	6 5	6 13	6 22	6 32	6 42	6 53	7 5
5	6 39	6 46	6 53	7 1	7 9	7 18	7 27	7 37	7 47	7 58	8 10	8 22	8 36	8 51	9 6
6	8 6	8 14	8 23	8 33	8 43	8 54	9 5	9 17	9 30	9 44	9 58	10 14	10 30	10 48	11 7
7	9 32	9 43	9 53	10 5	10 17	10 30	10 43	10 58	11 13	11 29	11 47	12 5	12 25	12 46	13 9
8	10 59	11 11	11 24	11 37	11 51	12 6	12 22	12 39	12 56	13 15	13 36	13 58	14 21	14 46	15 12
9	12 27	12 40	12 55	13 10	13 26	13 43	14 1	14 20	14 40	15 2	15 25	15 50	16 17	16 45	17 16
10	13 54	14 9	14 26	14 43	15 1	15 20	15 40	16 2	16 25	16 49	17 16	17 44	18 14	18 46	19 20
11	15 22	15 39	15 57	16 16	16 36	16 58	17 20	17 44	18 10	18 37	19 7	19 38	20 12	20 47	21 26
12	16 50	17 9	17 29	17 50	18 12	18 36	19 1	19 27	19 56	20 27	20 59	21 33	22 11	22 51	23 34
13	18 19	18 39	19 1	19 24	19 48	20 14	20 42	21 11	21 43	22 16	22 52	23 30	24 11	24 55	25 42
14	19 48	20 10	20 34	20 59	21 25	21 54	22 24	22 56	23 30	24 8	24 46	25 28	26 13	27 1	27 53
15	21 17	21 41	22 7	22 34	23 3	23 34	24 7	24 42	25 19	25 59	26 41	27 27	28 16	29 9	30 6
16	22 47	23 13	23 41	24 10	24 42	25 15	25 50	26 28	27 8	27 52	28 38	29 28	30 21	31 19	32 21
17	24 17	24 45	25 15	25 47	26 21	26 57	27 35	28 16	28 59	29 46	30 36	31 30	32 28	33 31	34 39
18	25 48	26 18	26 50	27 24	28 1	28 39	29 20	30 5	30 52	31 42	32 36	33 35	34 38	35 46	37 0
19	27 19	27 52	28 26	29 3	29 42	30 22	31 7	31 55	32 45	33 40	34 38	35 42	36 50	38 4	39 25
20	28 52	29 26	30 3	30 42	31 24	32 8	32 56	33 47	34 41	35 40	36 43	37 51	39 5	40 26	41 55
21	30 25	31 2	31 41	32 23	33 7	33 55	34 46	35 40	36 39	37 42	38 50	40 4	41 24	42 52	44 29
22	31 59	32 38	33 20	34 5	34 52	35 43	36 38	37 36	38 39	39 47	41 0	42 20	43 47	45 23	47 9
23	33 34	34 16	35 0	35 48	36 39	37 33	38 31	39 34	40 42	41 55	43 14	44 41	46 16	48 0	49 57
24	35 10	35 54	36 42	37 32	38 26	39 24	40 27	41 34	42 47	44 6	45 32	47 6	48 49	50 44	52 53
25	36 47	37 34	38 25	39 18	40 16	41 18	42 25	43 37	44 56	46 21	47 54	49 37	51 30	53 37	56 1
26	38 25	39 15	40 9	41 7	42 8	43 15	44 26	45 44	47 8	48 41	50 22	52 14	54 20	56 41	59 23
27	40 5	40 58	41 55	42 57	44 3	45 14	46 31	47 57	49 26	51 6	52 57	55 1	57 20	60 0	63 7
28	41 40	42 43	43 44	44 49	46 0	47 16	48 39	50 9	51 48	53 38	55 40	57 58	60 35	63 29	67 21
29	43 30	44 30	45 35	46 45	48 0	49 22	50 51	52 30	54 18	56 18	58 34	61 9	64 10	67 48	72 28
30	45 15	46 19	47 28	48 41	50 4	51 32	53 9	54 56	56 55	59 9	61 41	64 39	68 14	72 49	
31	47 2	48 11	49 25	50 45	52 2	53 48	55 33	57 31	59 42	62 13	65 8	68 39	73 9		
32	48 52	50 5	51 25	52 51	54 25	56 9	58 5	60 15	62 43	65 35	69 3	73 28			

III. CATALOGUE of Eminent FIXED STARS: With their Number, Right Ascension, Declination for *January* 1, 1750, and annual Variation from thence. According to M. DE LA CAILLE.

Nº.	NORTHERN STARS NAMES, AND Places in their CONSTELLATIONS.	Bayer's Letters.	Magnitude	Right Ascen. in Degrees. ° ′ ″	R. Ascen. in Time. H. M. S.	Ann. Var. + S.	Declination North. ° ′ ″	Ann. Var. + ″
	THE							
1	Extreme of the Wing of *Pegasus*	γ	2	0 5 53,5	0 0 24	3,08	13 47 36,3	20,04
2	Shoulder of *Andromeda*	δ	3	6 30 15,0	0 26 1	3,16	29 29 18,3	20,01
3	Breast of *Cassiopea*	α	3	6 37 4,8	0 26 28	3,30	55 9 37,9	20,00
4	Waist of *Cassiopea*	γ	3	10 27 14,2	0 41 49	3,49	59 21 19,2	19,70
5	*Polar Star*	α	2	10 40 23,0	0 42 42	10,05		19,69
6	Waist of *Andromeda*	β	2	13 57 3,6	0 55 48	3,29	34 17 15,7	19,43
7	Knee of *Cassiopea*	δ	3	17 25 14,5	1 9 41	3,71	58 55 27,1	19,07
8	Leg of *Cassiopea*	ε	3	24 10 22,9	1 36 42	4,13	62 25 20,6	18,27
9	Preceding of the *Northern Triangle*	α	4	24 43 28,0	1 38 54	3,49	28 20 59,3	18,19
10	Middle of Two, at the Ear of the *Ram*	γ	4	24 57 46,3	1 39 51	3,27	18 3 34 0	18,16
11	Preceding Horn of the *Ram*	β	3	25 13 4,7	1 40 52	3,28	19 34 34,1	18,12
12	Foot of *Andromeda*	γ	2	27 9 56,5	1 48 40	3,61	41 7 0,5	17,82
13	Node of the *Fishes*	α	3	27 17 7,0	1 49 8	3,09	1 32 50,2	17,80
14	Following Horn of the *Ram*	α	3	28 17 5,0	1 53 8	3,34	22 16 9,6	17,63
15	Northern of the *Triangle*	β	4	28 41 15,6	1 54 45	3,48	33 47 28,2	17,56
16	Southern of the *Triangle*	γ	4	30 38 0,7	2 2 32	3,52	32 40 37,7	17,22
17	Following in the *Whale's Cheek*	γ	3	37 35 34,0	2 30 22	3,12	2 10 10,5	15,87
18	Northern in the *Flower de Luce*		4	38 16 0,0	2 33 4	3,53	28 11 26,3	15,73
19	Southern in the *Flower de Luce*		4	38 49 39,5	2 35 19	3,50	26 12 44,4	15,61
20	Shoulder of *Perseus*	γ	3	41 42 55,6	2 46 52	4,24	52 30 13,8	14,96
21	Jaw of the *Whale*	α	2	42 18 33,6	2 49 14	3,13	3 5 32,6	14,81
22	Head of *Medusa*	β	2	43 0 4,6	2 52 0	3,84	39 58 17,9	14,64
23	Bright Star of *Perseus*	α	2	46 39 22,5	3 6 37	4,19	48 56 46,6	13,74
24	Thigh of *Perseus*	δ	3	51 18 33,3	3 25 14	4,17	46 57 40,0	12,52
25	Brightest of the *Pleiades*	η	3	53 10 1,6	3 32 40	3,54	23 18 35,8	12,01
26	Extreme of the Foot of *Perseus*	ζ	3	54 37 4,6	3 38 28	3,72	31 7 2,6	11,60
27	Knee of *Perseus*	ε	3	55 17 24,1	3 41 10	3,94	38 15 41,6	11,41
28	First of the *Hyades*	γ	3	61 23 56,2	4 5 36	3,39	15 0 6,8	9,59
29	Second of the *Hyades*	δ	4	62 8 17,3	4 8 33	3,44	16 56 2,8	9,35
30	Northern Eye of the *Bull*	ε	3	63 30 42,4	4 14 3	3,48	18 36 13,7	8,93
31	Southern Eye of the *Bull*. Aldebaran	α	1	65 24 4,0	4 21 36	3,43	15 59 3,2	8,33
32	*Goat*	α	1	74 33 56,5	4 58 16	4,40	45 42 36,7	5,33
33	Northern Horn of the *Bull*	β	2	77 37 27,2	5 10 30	3,78	28 22 6,2	4,29
34	Western Shoulder of *Orion*	γ	2	77 56 2,2	5 11 44	3,22	6 5 55,7	4,19
35	Southern Horn of the *Bull*	ζ	3	80 40 42,9	5 22 43	3,58	20 57 52,7	3,24
36	Shoulder of the *Coachman*	β	3	85 17 57,8	5 41 12	4,41	44 53 16,5	1,64
37	Eastern Shoulder of *Orion*	α	1	85 24 46,2	5 41 39	3,25	7 20 10,6	1,60
38	Hand of the *Coachman*	θ	3	85 40 8,5	5 42 41	4,08	37 9 51,6	1,51
39	Foot of *Castor*	η	4	89 56 36,3	5 59 48	3,63	21 33 15,5	0,02
40	Foot of *Pollux*, the brightest	μ	4	91 58 25,0	6 7 54	3,63	22 30 59,2	— 0,07
41	Bright Star in the Foot of *Pollux*	γ	3	95 48 54,7	6 23 16	3,48	16 35 16,9	2,02
42	Knee of *Castor*	ε	3	97 8 9,0	6 28 33	3,71	25 21 9,4	2,49
43	Knee of *Pollux*	ζ	3	102 18 49,4	6 49 15	3,58	20 54 45,1	4,27
44	Thigh of *Pollux*	δ	3	106 17 26,4	7 5 10	3,61	22 25 8,5	5,61
45	Neck of the *Little Dog*	β	3	108 23 46,5	7 13 35	3,27	8 46 20,2	6,32
46	Bright Star in the Head of *Castor*	α	2	109 39 2,7	7 18 36	3,87	32 24 34,5	6,73
47	Brightest in the *Little Dog*. Procyon	α	1	111 32 59,4	7 26 12	3,21	5 50 42,5	7,35
48	Head of *Pollux*	β	2	112 29 45,6	7 29 59	3,75	28 36 22,5	7,66
49	Southern Foot of the *Crab*	β	4	120 44 4,3	8 2 56	3,15	9 56 7,0	10,23
50	Northern *Ass*	γ	4	127 11 42,2	8 27 47	3,52	22 20 59,3	12,11
51	Southern *Ass*	δ	4	127 36 43,4	8 30 27	3,44	19 3 22,0	12,22

III.

III. A CATALOGUE of Eminent FIXED STARS: With their Number, Right Ascension, Declination for *January* 1, 1750, and annual Variation from thence.

N°.	NORTHERN STARS NAMES, AND Places in their CONSTELLATIONS.	Bayer's Letters.	Magnitude	Right Ascen. in Degrees. ° ′ ″	R. Ascen. in Time. H. M. S.	Ann. Var. + S.	Declination North. ° ′ ″	Ann. Var. − ″
	THE							
52	Northern in the Foot of the *Great Bear*	ι	3	130 29 7,9	8 41 57	4,25	48 59 58,7	13,00
53	Claw of the *Crab*	α	3	130 32 21,3	8 42 9	3,31	12 48 33,5	13,01
54	Southern in the Foot of the *Great Bear*	κ	4	131 36 28,0	8 46 26	4,20	48 7 16,6	13,30
55	Preceding Knee of the *Great Bear*	θ	3	138 59 39,2	9 15 59	4,22	52 47 42,3	15,11
56	Foot of the *Lion*	ο	4	141 56 46,0	9 27 47	3,24	10 40 56,5	15,79
57	Eye of the *Lion*	ε	3	142 54 6,0	9 31 36	3,45	24 24 35,2	15,99
58	Northern of the Head of the *Lion*	μ	3	144 37 21,0	9 38 29	3,47	27 10 8,5	16,33
59	Southern in the Neck of the *Lion*	η	3	148 24 53,8	9 53 40	3,31	17 58 18,4	17,07
60	Heart of the *Lion*. *Regulus*	α	1	148 45 26,0	9 55 2	3,24	13 10 43,7	17,13
61	Northern in the Neck of the *Lion*	ζ	3	150 40 55,0	10 2 44	3,34	24 39 4,0	17,47
62	Following in the Neck of the *Lion*	γ	3	151 32 6,1	10 6 0	3,31	21 5 49,3	17,61
63	In the *Belly* of the *Lion*	ρ	4	154 54 20,0	10 19 37	3,18	10 35 6,4	18,14
64	Southern in the □ of the *Great Bear*	β	2	161 38 26,5	10 46 34	3,75	57 42 51,0	19,01
65	Northern following in the *Great Bear*	α	2	162 0 45,1	10 48 3	3,89	63 5 33,9	19,05
66	Thigh of the *Lion*	δ	3	165 11 27,2	11 0 46	3,22	21 53 28,6	19,37
67	Back of the *Lion*	θ	3	165 16 13,1	11 1 5	3,18	16 47 32,5	19,38
68	Tail of the *Lion*	β	2	174 4 17,4	11 36 17	3,12	15 58 7,2	19,93
69	Northern Wing of the *Virgin*	β	3	174 25 5,0	11 37 40	3,08	3 10 20,5	19,94
70	Southern following in the □ of the *Gr. Bear*	γ	2	175 8 7,1	11 40 32	3,24	55 5 0,7	19,98
71	Last in the □ of the *Great Bear*	δ	2	180 43 47,3	12 2 55	3,05	58 25 19,3	20,04
72	Southern Wing of the *Virgin*	η	3	181 46 48,1	12 7 7	3,07	0 43 31,1	20,02
73	First of the Tail of the *Great Bear*	ε	2	190 44 5,6	12 42 56	2,69	57 19 15,1	19,69
74	Foregoing in the Waist of the *Virgin*	δ	3	190 45 18,1	12 43 1	3,06	4 45 43,2	19,69
75	The brightest under the *Great Bear*		3	191 4 20,0	12 44 17	2,86	39 40 25,8	19,66
76	Northern Wing of the *Virgin*	ε	3	192 25 51,8	12 49 43	3,01	12 18 34,3	19,57
77	Middle of the *Tail* of the *Great Bear*	ζ	2	198 26 53,8	13 13 48	2,45	56 14 12,2	19,01
78	Following in the Waist of the *Virgin*	ζ	3	200 29 37,0	13 21 58	3,08	0 41 27,5	18,77
79	Extremity of the Tail of the *Great Bear*	η	2	204 24 58,6	13 37 40	2,41	50 34 5,4	18,24
80	Preceding Thigh of the *Cowherd*, or *Clown*	η	3	205 41 34,1	13 42 46	2,88	19 39 45,0	18,06
81	Extremity of the *Dragon's Tail*	α	3	209 24 28,7	13 57 38	1,50	65 34 32,5	17,45
82	Brightest of the *Clown*. *Arcturus*	α	1	211 4 1,0	14 4 16	2,82	20 29 39,2	17,16
83	Preceding Shoulder of the *Clown*	γ	3	215 29 55,5	14 22 0	2,43	38 24 19,0	16,31
84	Following Foot of the *Clown*	ζ	3	217 18 14,6	14 29 13	2,86	14 48 52,2	15,93
85	Following Thigh of the *Clown*	ε	3	218 32 15,8	14 34 9	2,63	28 8 27,0	15,67
86	Preceding in □ of the *Little Bear*	β	3	222 55 42,3	14 51 43	0,36 —		14,66
87	Head of the *Clown*, or *Cowherd*	β	3	223 8 0,0	14 52 32	2,28	41 23 15,7	14,62
88	Following Shoulder of the *Clown*	δ	3	226 23 12,5	15 5 33	2,44	34 15 40,8	13,82
89	Preceding in the last Joint of the *Dragon*	ι	4	229 51 2,1	15 19 24	1,31	59 50 54,3	12,91
90	Following in □ of the *Little Bear*	γ	3	230 19 58,5	15 21 20	0,22 —		12,79
91	Preceding in Neck of the *Serpent*	δ	3	230 43 9,0	15 22 53	2,87	11 23 32,0	12,68
92	Brightest in the *Crown*	α	2	231 1 40,2	15 24 7	2,05	27 34 18,2	12,60
93	Brightest in the Neck of the *Serpent*	α	3	232 59 39,8	15 31 59	3,01	7 13 50,5	12,06
94	Southern in the Neck of the *Serpent*	β	3	233 39 52,0	15 34 39	2,76	16 13 16,9	11,87
95	Following the brightest of the *Serpent*	ι	4	234 35 30,2	15 38 22	2,98	5 14 56,2	11,62
96	Following of Southern in *Serpent's* Neck	γ	3	236 13 52,5	15 44 55	2,75	14 29 41,4	11,14
97	Following in the last Joint of the *Dragon*	θ	4	239 18 37,2	15 57 14	1,14	59 14 17,5	10,23
98	Preceding Arm of *Hercules*	γ	3	242 43 30,8	16 10 54	2,66	19 45 29,6	9,18
99	Preceding Shoulder of *Hercules*	β	3	244 52 29,7	16 19 30	2,59	22 3 7,1	8,51
100	Last Joint of the *Dragon*	η	4	245 9 46,9	16 20 39	0,78	62 5 2,5	8,41
101	Foregoing in the Side of *Hercules*	ζ	3	247 58 6,2	16 31 52	2,30	32 4 19,4	7,51
102	Loins of *Hercules*	η	4	248 34 59,6	16 34 20	2,07	39 24 46,9	7,31

III. A CATALOGUE of Eminent FIXED STARS: With their Number, Right Ascension, Declination for *January* 1, 1750, and annual Variation from thence.

N°.	NORTHERN STARS NAMES, AND Places in their CONSTELLATIONS.	Bayer's Letters.	Magnitude.	Right Ascen. in Degrees. ° ' "	R. Ascen. in Time. H. M. S.	Ann. Var. + S.	Declination North. ° ' "	Ann. Var. − "
	THE							
103	Following in the Side of *Hercules*	ι	3	252 40 52,2	16 50 43	2,29	31 18 41,6	5,96
104	Head of *Hercules*	α	2	255 48 49,2	17 3 15	2,74	14 41 44,5	4,91
105	Following Shoulder of *Hercules*	δ	3	256 26 36,4	17 5 46	2,47	25 9 4,7	4,69
106	Head of *Ophiuchus*	α	2	260 50 5,3	17 23 20	2,78	12 45 47,9	3,17
107	Eye of the *Dragon*	β	3	261 12 6,8	17 24 48	1,36	52 29 44,5	3,06
108	Northern in Shoulder of *Ophiuchus*	β	3	262 46 55,0	17 31 8	2,97	4 41 40,6	2,52
109	Southern in Shoulder of *Ophiuchus*	γ	3	263 50 35,2	17 35 22	3,01	2 49 28,3	2,15
110	Elbow of *Hercules*	μ	4	264 10 9,5	17 36 41	2,38	27 53 3,9	2,03
111	Knee of *Hercules*	θ	3	266 55 25,6	17 47 42	2,06	37 17 56,4	1,08
112	Head of the *Dragon*	γ	3	267 42 3,0	17 50 48	2,21	51 31 37,9	0,80
								+
113	Brightest in the *Harp*	α	1	277 7 7,0	18 28 28	2,06	38 34 0,0	2,48
114	Preceding in the Lozange of the *Harp*	β	3	280 12 47,3	18 40 51	2,22	33 5 23,4	3,55
115	Preceding in the Extremity of *Serpent's Tail*	θ	4	280 56 51,2	18 43 47	3,00	3 54 6,0	3,80
116	Following in the Lozange of the *Harp*	δ	3	281 26 36,3	18 45 46	2,11	36 35 48,6	3,97
117	Preceding in the Tail of the *Eagle*	ε	4	282 4 17,5	18 48 17	2,73	14 44 56,1	4,18
118	Following in the Lozange of the *Harp*	γ	3	282 23 54,3	18 49 36	2,26	32 21 49,0	4,29
119	Following in the Tail of the *Eagle*	ζ	4	283 28 50,4	18 53 55	2,69	13 30 42,5	4,67
120	Second Joint of the *Dragon*	δ	3	288 6 23,0	19 12 26	0,06	67 13 17,1	6,22
121	Preceding Wing of the *Eagle*	δ	3	288 13 24,7	19 12 54	3,02	2 38 18,2	6,26
122	Beak of the *Swan*	β	3	290 9 25,3	19 20 38	2,43	27 27 4,0	6,90
123	Brightest of the *Arrow*	α	4	292 14 1,0	19 28 56	2,69	17 27 28,9	7,58
124	Preceding in the Neck of the *Eagle*	γ	3	293 35 30,2	19 34 22	2,28	10 1 22,0	8,02
125	Northern Wing of the *Swan*	δ	3	294 17 28,4	19 37 10	1,86	44 31 58,5	8,24
126	Brightest of the *Eagle*	α	2	294 38 46,7	19 38 35	2,91	8 13 44,3	8,36
127	Following Shoulder of *Antinous*	η	4	294 55 55,0	19 39 44	3,07	0 23 5,4	8,45
128	Following in Neck of the *Eagle*	β	3	295 45 31,0	19 43 2	3,02	5 48 10,6	8,71
129	Breast of the *Swan*	γ	3	303 18 50,0	20 13 15	2,16	39 8 12,8	11,00
130	Preceding in Tail of the *Dolphin*	ε	4	305 18 56,4	20 21 16	2,88	10 28 20,0	11,58
131	Preceding in the Lozange of the *Dolphin*	ζ	4	305 54 17,8	20 23 37	2,82	13 49 52,2	11,74
132	Southerly in the Lozange of the *Dolphin*	β	3	306 27 34,3	20 25 50	2,82	13 44 32,6	11,91
133	Northerly in the Lozange of the *Dolphin*	α	3	307 0 22,2	20 28 1	2,79	15 2 51,5	12,05
134	Southerly following in the Loz. of the *Dolphin*	δ	4	307 56 44,9	20 31 47	2,81	14 11 36,6	12,32
135	Tail of the *Swan*	α	2	308 13 38,5	20 32 55	2,05	44 23 54,5	12,39
136	*Last* in Lozange of *Dolphin*	γ	4	308 46 3,0	20 35 4	2,79	15 14 22,5	12,54
137	Brightest in Southern Wing of the *Swan*	ε	3	309 1 19,6	20 36 5	2,40	33 2 50,4	12,62
138	Extremity of Southern Wing of the *Swan*	ζ	4	315 34 26,4	21 2 18	2,55	29 12 50,7	14,31
139	Head of the *little Horse*	α	4	315 49 36,0	21 3 18	3,01	4 14 8,1	14,37
140	First of *Pegasus*	e	4	317 37 25,3	21 10 30	2,79	18 44 53,7	14,80
141	Preceding Shoulder of *Cepheus*	α	3	318 8 41,8	21 12 34	1,43	61 31 55,7	14,92
142	Girdle of *Cepheus*	β	4	321 19 34,4	21 25 18	0,81	69 27 54,8	15,64
143	Mouth of *Pegasus*	ε	3	322 58 21,6	21 31 53	2,95	8 44 29,8	16,00
144	Lower Part of Southern Wing of the *Swan*	μ	4	323 14 41,1	21 32 59	2,64	27 37 24,1	16,05
145	Neck of *Pegasus*	ζ	3	337 14 43,9	22 28 59	2,99	9 [illegible] 4,3	18,46
146	Northern in the Knee of *Pegasus*	η	3	337 49 37,7	22 31 18	2,80	28 55 14,5	18,55
147	Ring of the Chain of *Andromeda*	ο	4	342 36 49,0	22 50 27	2,72	40 59 22,0	19,12
148	Thigh of *Pegasus*	β	2	342 55 14,5	22 51 41	2,89	26 43 52,7	19,15
149	Wing of *Pegasus*	α	2	343 4 57,3	22 52 20	2,99	13 51 56,0	19,17
150	Following Foot of *Cepheus*	γ	4	352 19 22,1	23 29 17	2,31		19,86
151	Head of *Andromeda*	α	2	358 52 44,1	23 55 31	3,06	27 42 32,1	20,04
152	Chair of *Cassiopea*	β	3	358 59 41,4	23 55 59	3,04	57 46 7,0	20,04

III.

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	THE							
1	Tail of the Male *Hydra*	β	3	3 2 58,3	0 12 12	2,72	78 39 50,3	20,01
2	Head of the *Phœnix*	α	2	3 28 0,9	0 13 52	3,01	43 39 43,4	20,00
3	Brightest in the *Whale's Tail*	β	2	7 45 28,6	0 31 2	3,01	19 21 51,1	19,85
4	Thigh of the *Phœnix*	β	3	13 43 21,7	0 54 53	2,73	48 4 42,1	19,46
5	Preceding towards the *Whale's Tail*	η	4	14 0 16,1	0 56 1	3,00	11 30 48,8	19,44
6	Following towards the *Whale's Tail*	θ	4	17 53 9,1	1 11 33	3,01	9 28 49,5	19,07
7	Following Wing of the *Phœnix*	γ	3	19 22 10,7	1 17 29	2,67	44 36 18,8	18,90
8	Source of the River. *Achernar*	α	1	22 5 42,2	1 28 23	2,26	58 30 52,1	18 56
9	Head of the Male *Hydra*	α	3	27 43 22,5	1 50 53	1,87	62 47 36,3	17,73
10	Variable of the *Whale*	o	4	31 40 53,8	2 6 44	3,03	4 7 28,0	17,05
11	Preceding in the Cheek of the *Whale*	δ	3	36 40 35,4	2 26 42	3,08	0 45 50,2	16,07
12	Breast of the *Whale*	ι	3	36 52 22,9	2 27 30	2,90	12 56 51,9	16,03
13	*First* Turning of the *River*	θ	3	42 11 52,7	2 48 48	2,30	41 19 4,0	14.85
14	*Third* Turning of the *River*		4	45 21 58,8	3 1 28	2,54	29 59 13,7	14,07
15	River, before the *Whale*	ζ	3	45 55 39,1	3 3 43	2.91	9 45 51,2	13.93
16	Following, in the *River*	ε	3	50 17 32,0	3 21 10	2,89	10 19 12,0	12,79
17	Following in the *River*	δ	3	52 49 30,1	3 31 18	2,88	10 37 32,0	12,10
18	*Fourth* Turn of the *River*	γ	3	56 35 48,3	3 46 23	2,79	14 14 21,6	11,02
19	Middle of the *Male Hydra*	γ	4	57 51 51,2	3 51 27	1,14 —	74 59 55,9	10,66
20	Brightest in the rhomboidal *Reticula*	α	3	62 49 11,8	4 11 17	0,74	63 6 16,3	9,15
21	Tail of the Gold-Fish, or *Dorade*	α	3	67 9 19,7	4 28 37	1,28	55 34 12,9	7,78
22	*Last* of the *River*	β	3	73 53 44,0	4 55 35	2,95	5 25 49,2	5,56
23	Bright Foot of *Orion*. *Rigel*	β	1	75 38 12,2	5 2 33	2,89	8 30 37,4	4,97
24	Northern in the Sword of *Orion*	η	3	77 58 48,0	5 11 55	3,02	2 38 56,9	4,17
25	Belly of the *Hare*	β	4	79 23 11,8	5 17 33	2,58	20 58 43,1	3,69
26	Preceding of *Orion's Girdle*	δ	2	79 48 54,4	5 19 16	3,07	0 30 22,8	3,54
27	Brightest of the *Hare*	α	3	80 25 49,7	5 21 43	2,65	18 1 19,0	3,34
28	Middle of *Orion's Girdle*	ε	2	80 53 11,1	5 23 33	3,05	1 23 1,2	3,17
29	*Last* of *Orion's Girdle*	ζ	2	82 2 33,5	5 28 10	3,04	2 5 48,9	2,77
30	Preceding of the brightest of the *Dove*	α	2	82 39 12,2	5 30 37	2,20	34 13 22,7	2,56
31	Belly of the Gold-Fish, or *Dorade*	β	4	82 52 17,5	5 31 19	0,50	62 39 29,7	2,48
32	Southern in the *Hare's Foot*	γ	4	83 30 43,2	5 34 3	2,53	22 32 58 7	2,26
33	Knee of *Orion*	κ	3	83 58 48,2	5 35 55	2,85	9 46 38,3	2,10
34	Northern in the *Hare's Foot*	δ	4	85 8 46,0	5 40 35	2,57	20 55 16,1	1,68
35	Following of the brightest of the *Dove*	β	3	85 32 30,4	5 42 10	2,11	35 52 40,3	1,55
								+
36	Preceding Foot of the *Great Dog*	ζ	3	92 40 58,9	6 10 44	2,31	29 58 11,8	0,94
37	Knee of the *Great Dog*	β	3	92 55 25,3	6 11 42	2,63	17 51 11,4	1,02
38	Brightest of the Ship. *Canopus*	α	1	94 36 7,6	6 18 25	1,34	52 34 8,9	1,60
39	Summit of the Ship's *Rudder*	ν	3	97 31 44.4	6 30 7	1,84	42 59 25,2	2,62
40	Brightest of the *Great Dog*. *Syrius*	α	1	98 32 0,3	6 34 8	2.69	16 23 36,6	2,97
41	Thigh of the *Great Dog*	ε	3	102 12 7,2	6 48 48	2,36	28 38 59,6	4,23
42	Back of the *Great Dog*	δ	2	104 33 26,8	6 58 14	2,45	26 0 56,1	5,03
43	Poop or Stern of the *Ship*	π	3	107 4 44,0	7 8 19	2,13	36 39 41,4	5,88
44	Tail of the *Great Dog*	η	2	108 33 3,6	7 14 12	2,39	28 49 59,7	6,37
45	Poop of the *Ship*	σ	3	110 19 40,5	7 21 19	1,94	42 48 25,6	6,96
46	Poop of the *Ship*	ζ	2	118 42 4,5	7 54 48	2,12	39 18 39,5	9,62
47	Preceding, in Body of the *Ship*	γ	2	120 27 48,0	8 1 51	1,85	46 36 34,9	10,16
48	Following in Body of the *Ship*	ι	3	124 20 10,7	8 17 21	1,26	58 42 52,5	11,30
49	Brightest in Middle of the *Ship*	δ	2	129 27 5,0	8 37 48	1,61	53 48 2,1	12,73
50	Sail of the *Ship*	λ	3	134 42 17,7	8 57 49	2,21	42 26 4,1	14,69
51	Brightest about the Oars of the *Ship*	β	1	137 35 26,0	9 10 22	0,75	68 41 26,5	14,79
52	Mast of the *Ship*	ι	3	137 36 3,3	9 10 24	1,65	58 14 8,3	14,79

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	THE							
53	Brightest more *Northerly*	κ	3	138 35 52,9	9 14 24	1,86	53 57 0,1	15,03
54	Heart of the female *Hydra*	α	2	138 49 40,0	9 15 19	2,96	7 35 13,1	15,08
55	Oars of the *Ship*	υ	3	145 12 41,2	9 40 51	1,50	63 55 6,7	16,45
56	Southern in Section of the *Ship*	θ	3	158 31 34,9	10 34 6	2,12	63 5 24,9	18,64
57	Northern in Section of the *Ship*	η	2	158 51 29,3	10 35 26	2,27	58 22 39,2	18,68
58	Top of the *Ship's Section*	μ	3	159 1 11,4	10 36 5	2,55	48 6 15,0	18,81
59	Foot of the *Cup*	α	4	161 54 13,7	10 47 37	2,95	16 58 29,0	19,05
60	Preceding in the Crupper of the *Centaur*	δ	3	178 51 51,4	11 55 27	3,05	49 19 39,8	20,03
61	Beak of the *Raven*	α	4	178 53 31,4	11 55 34	3,07	23 20 6,0	20,03
62	Head of the *Raven*	ε	4	179 19 46,1	11 57 19	3,06	21 13 44,6	20,04
63	Preceding Arm of the *Cross*	δ	3	180 30 34,7	12 2 2	3,10	57 21 30,0	20,04
64	Preceding Wing of the *Raven*	γ	3	180 44 44,5	12 2 59	3,09	16 9 32,5	20,04
65	Foot of the *Cross*	α	1	183 13 53,7	12 12 56	3,22	61 42 47,4	20,01
66	Preceding in following Wing of the *Raven*	δ	4	184 14 29,6	12 16 58	3,09	15 7 18,2	19,98
67	Head of the *Cross*	γ	2	184 28 35,0	12 17 54	3,36	70 44 54,3	19,97
68	Foot of the *Raven*	β	3	185 19 30,9	12 21 18	3,14	22 0 40,0	19,95
69	Preceding of the *Fly*	α	4	185 38 41,6	12 22 35	3,42	67 46 17,2	19,94
70	Top of the *Centaur's Crupper*	γ	2	186 57 53,8	12 27 52	3,27	47 34 52,9	19,89
71	Southern in the *Virgin's Girdle*	γ	3	187 15 7,2	12 29 0	3,08	0 4 22,3	19,88
72	Head of the *Fly*	β	4	187 48 53,4	12 31 16	3,52	66 44 6,1	19,84
73	Following Arm of the *Cross*	β	2	188 19 40,1	12 33 19	3,42	58 19 8,3	19,83
74	Southern Wing of the *Virgin*	θ	4	194 15 26,2	12 57 2	3,09	4 11 47,2	19,41
75	Tail of the *female Hydra*	γ	3	196 20 46,6	13 5 23	3,22	21 50 43,8	19,22
76	Preceding Shoulder of *Centaur*	ι	3	196 39 27,6	13 6 38	3,34	35 23 6,6	19,20
77	*Spike* of the *Virgin*	α	1	198 0 51,4	13 12 3	3,15	9 50 51,1	19,06
78	Belly of the *Centaur*	ε	3	201 3 30,4	13 24 14	3,69	52 10 55,2	18,70
79	Waist of the *Centaur*	ζ	3	205 1 14,6	13 40 5	3,66	46 2 38,3	18,15
80	Preceding Leg of the *Centaur*	β	2	206 36 41,8	13 46 27	4,09	59 9 1,8	17,91
81	Following Shoulder of the *Centaur*	θ	3	207 59 57,5	13 52 0	3,52	35 7 34,9	17,69
82	Robe of the *Virgin*	κ	4	209 53 57,8	13 59 36	3,19	9 5 43,3	17,37
83	Southern Foot of the *Virgin*	λ	4	211 24 18,4	14 5 37	3,22	12 12 29,0	17,20
84	Southern in the Shield of the *Centaur*	η	3	214 56 9,1	14 19 45	3,75	41 2 28,8	16,43
85	Head of the *Compasses*	α	3	215 39 45,4	14 22 39	4,68	63 51 48,2	16,26
86	Brightest in the Foot of the *Centaur*	α	1	215 42 31,1	14 22 50	4,41	59 47 9,4	16,26
87	Foot of the *Wolf*	α	3	216 21 48,0	14 25 27	3,89	46 17 40,1	16,14
88	Southern Scale of the *Ballance*	α	2	219 16 20,9	14 37 5	3,30	14 59 9,7	15,50
89	Extremity of the Foot of the *Wolf*	β	3	220 34 6,6	14 42 16	3,86	42 6 13,9	15,22
90	Following Foot of the *Centaur*	κ	3	220 45 12,7	14 43 1	3,84	41 4 45,6	15,17
91	Preceding Claw of the *Scorpion*	γ	4	222 22 28,5	14 49 30	3,48	24 16 53,5	14,70
92	Preceding of Southern *Triangle*	γ	3	224 0 2,8	14 56 0	5,29	67 43 32,3	14,40
93	The Northern Scale of the *Ballance*	β	2	225 53 50,2	15 3 35	3,30	8 26 30,5	13,94
94	Following in Shoulder of the *Wolf*	γ	3	229 38 36,2	15 18 34	3,94	40 18 4,6	12,97
95	Following in Northern *Scale* of the *Ballance*	γ	4	230 23 42,6	15 21 35	3,34	13 56 10,4	12,77
96	Top of the Southern *Triangle*	β	3	233 20 42,1	15 33 23	5,06	62 37 34,2	11,96
97	Southern Claw of the *Scorpion*	ρ	4	235 22 40,5	15 41 31	3,68	28 27 36,0	11,38
98	Southern in the Forehead of the *Scorpion*	π	4	235 56 38,8	15 43 47	3,60	25 22 18,7	11,32
99	Middle of the Forehead of the *Scorpion*	δ	3	236 23 52,2	15 45 35	3,52	21 53 17,6	11,09
100	Northern in the Forehead of the *Scorpion*	β	2	237 44 7,0	15 50 56	3,50	19 5 55,2	10,69
101	Top of the Forehead of the *Scorpion*	ν	4	239 15 5,4	15 57 0	3,47	18 47 19,6	10,24
102	Preceding Foot of *Ophiuchus*	δ	3	240 18 58,8	16 1 16	3,14	3 1 46,3	9,92
103	Following in the same Foot of *Ophiuchus*	ε	3	241 16 51,2	16 5 7	3,16	4 3 36,0	9,63

III.

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	THE							
104	Preceding of the *Scorpion's Heart*	σ	4	241 30 40,7	16 6 3	3,62	24 58 2,9	9,56
105	Brightest in the *Scorpion's Heart. Antares*	α	1	243 31 52,8	16 14 8	3,66	25 51 8,4	8,93
106	Following of the *Scorpion's Heart*	τ	4	245 5 32,3	16 20 22	3,70	27 40 14,7	8,44
107	Following of the Southern *Triangle*	α	3	245 37 5,0	16 22 28	6,16	68 31 24,3	8,26
108	Southern in the *Knee* of *Ophiuchus*	ζ	3	245 51 19,0	16 23 25	3,30	10 2 16,0	8,20
109	First Joint of the *Scorpion's Tail*	ε	3	248 30 14,8	16 34 1	3,90	33 48 41,1	7,34
110	Second Joint of the *Scorpion's Tail*	μ	3	248 44 54,6	16 35 0	4,04	37 35 18,6	7,26
111	Brightest in the third *Joint*	ζ	3	249 15 51,0	16 37 3	4,20	41 54 3,6	7,09
112	*Fourth* Joint	η	3	253 34 34,1	16 54 18	4,28	42 52 39,2	5,66
113	Following Knee of *Ophiuchus*	η	2	254 0 53,9	16 56 4	3,44	15 23 28,4	5,52
114	Following Foot of *Ophiuchus*	θ	3	256 40 11,2	17 6 21	3,67	24 43 20,6	4,61
115	Middle of the *Altar*	α	3	258 8 27,0	17 12 34	4,61	49 38 31,8	4,12
116	Little Star in Extremity of *Scorpion's Tail*	υ	4	258 27 0,8	17 13 48	4,09	37 3 55,9	4,01
117	Brightest in Extremity of the *same Tail*	λ	3	259 9 59,4	17 16 40	4,08	36 53 28,6	3,77
118	5th Joint of the *Scorpion's Tail*	θ	3	259 50 56,1	17 19 24	4,30	42 48 23,2	3,53
119	7th Joint of the *same Tail*	κ	3	261 18 19,3	17 25 13	4,13	38 52 14,6	3,03
120	6th Joint of the *same Tail*	ι	3	262 31 53,5	17 30 8	4,18	39 59 49,0	2,60
121	In the last Joint of the *Serpent*	ζ	4	266 49 26,9	17 47 18	3,16	3 38 56,3	1,11
122	Follows at the Point of the *Arrow* of *Sagittary*	γ	4	267 26 21,5	17 49 45	3,87	30 23 53,7	0,89
123	Top of the Bow of *Sagittary*	μ	4	269 42 12,7	17 58 49	3,60	21 5 56,9	0,10
124	Foot of *Sagittary*	δ	3	271 14 31,8	18 4 58	3,85	29 54 18,4	— 0,43
125	Southern Extreme of the *Bow of Sagittary*	ε	3	271 53 39,7	18 7 35	4,00	34 28 17,4	0,67
126	Northern Extreme of the *Bow of Sagittary*	λ	3	273 8 5,2	18 12 32	3,72	25 31 57,4	1,09
127	Arrow of *Sagittary*	φ	4	277 30 26,7	18 30 2	3,77	27 13 13,0	2,61
128	Preceding Shoulder of *Sagittary*	τ	3	279 56 13,4	18 39 45	3,74	26 34 51,0	3,45
129	Arm of *Sagittary*	ζ	3	281 40 16,6	18 46 41	3,84	30 12 36,0	4,06
130	Head of *Sagittary*	ο	4	282 25 19,1	18 49 41	3,60	22 5 0,8	4,31
131	Preceding Shoulder of *Sagittary*	τ	4	282 49 38,3	18 51 19	3,77	28 0 30,6	4,45
132	Following in the Head of *Sagittary*	π	3	283 35 45,4	18 54 23	3,59	21 23 48,8	5,70
133	Preceding of 2 in Foot of *Sagittary*	β	4	286 9 8,7	19 4 37	4,34	44 53 42,4	5,57
134	Leg of *Sagittary*	α	4	286 37 43,3	19 6 31	4,20	41 3 21,5	5,73
135	Side of *Antinous*	ι	4	290 58 30,6	19 23 54	4,01	1 49 12,2	7,17
136	Back of the *Peacock*	δ	4	295 58 55,0	19 43 56	5,92	66 46 50,8	8,78
137	Brightest preceding in the Head of *Capricorn*	α	3	300 56 28,9	20 3 46	3,35	13 18 2,8	10,30
138	Eye of the *Peacock*	α	2	301 25 20,0	20 5 41	4,89	57 30 27,4	10,44
139	Following in the Head of *Capricorn*	β	3	301 44 3,0	20 6 56	3,39	15 33 2,7	10,54
140	Zagaye of the *Indian*	α	3	304 57 56,9	20 19 52	4,29	48 8 14,0	11,48
141	Wing of the *Peacock*	β	3	305 31 18,6	20 22 5	5,65	67 4 8,5	11,64
142	Breast of the *Peacock*	γ	4	316 21 5,2	21 5 24	5,28	66 28 19,8	14,50
143	Preceding Shoulder of *Aquarius*	β	3	319 35 53,7	21 18 24	3,18	6 39 22,4	15,35
144	Preceding in the Tail of the *Goat*	γ	3	321 27 12,5	21 25 49	3,35	17 46 42,0	15,66
145	Following in the Tail of the *Goat*	δ	3	323 18 8,6	21 23 13	3,33	17 14 48,3	16,06
146	Head of the *Crane*	γ	3	324 40 33,5	21 38 42	3,70	38 31 28,7	16,35
147	Preceding Wing of the *Crane*	α	2	328 5 7,7	21 52 21	3,98	48 9 21,4	17,00
148	Following Shoulder of *Aquarius*	α	3	328 14 0,6	21 52 56	3,10	1 31 25,9	17,03
149	Beak of the *Toucan*	α	3	330 16 46,0	22 1 7	4,31	61 29 34,0	17,40
150	Following Arm of *Aquarius*	γ	3	332 11 5,6	22 8 44	3,09	2 38 13,5	17,71
151	Thigh of the *Crane*	β	3	336 54 3,2	22 27 36	3,68	48 10 51,0	18,43
152	Water of the *Water-Bearer*	λ	4	339 53 27,8	22 39 34	3,16	8 54 8,2	18,82
153	Leg of the *Water-Bearer*	δ	3	340 20 14,6	22 41 21	3,22	17 8 39,9	18,87
154	Brightest of the Southern *Fishes. Fomalhaut*	α	1	340 56 41,7	22 43 47	3,34	30 56 24,8	18,94
155	Water of the *Water-Bearer*	φ	4	354 20 23,1	23 1 22	3,13	7 23 31,2	19,38

SMALL EQUATIONS of CLOCK-TIME, and of the SUN's Place and Declination, for every 4th Year from 1750, (or from any common, or Leap-Year after) to 1800, N. S. Which will ferve, with contrary Sign, back to 1700, N. or O. Style. According to M. *De la Caille*'s Motions.

Days	January.			February.			March.			April.			May.			June.		
	Eqn. Time.	Eq. ☉ Place.	Eq. ☉ Decln	Eqn. Time.	Eq. ☉ Place.	Eq. ☉ Decl.	Eqn. Time.	Eq. ☉ Place.	Eq. ☉ Decl.	Eqn. Time.	Eq. ☉ Place.	Eq. ☉ Decl.	Eqn. Time.	Eq. ☉ Place.	Eq. ☉ Decl.	Eqn. Time.	Eq. ☉ Place.	Eq. ☉ Decl.
	+	+	−	−	+	−	−	+	−	−	+	+	−	+	+	+	+	+
	th.	′ ″	′ ″	th.	′ ″	′ ″	th.	′ ″	′ ″	th.	′ ″	′ ″	th.	′ ″	′ ″	th.	′ ″	′ ″
1	19	1 44	0 10	2	1 47	0 33	41	1 47	0 43	39	1 48	0 41	2	1 48	0 29	47	1 51	0 14
2	17	1 44	0 12	4	1 47	0 32	41	1 47	0 43	38	1 48	0 41	1	1 48	0 29	47	1 52	0 13
3	16	1 44	0 12	6	1 47	0 34	43	1 47	0 43	37	1 48	0 41	− 0	1 48	0 29	46	1 52	0 12
4	17	1 44	0 14	7	1 47	0 34	44	1 47	0 44	36	1 47	0 41	+ 1	1 48	0 28	47	1 52	0 11
5	16	1 44	0 14	9	1 47	0 34	45	1 47	0 44	35	1 48	0 41	2	1 48	0 28	47	1 52	0 11
6	18	1 45	0 15	11	1 47	0 35	45	1 47	0 43	34	1 47	0 41	3	1 48	0 28	48	1 52	0 9
7	17	1 45	0 17	12	1 47	0 36	45	1 47	0 44	34	1 48	0 40	4	1 48	0 27	48	1 52	0 9
8	17	1 45	0 17	13	1 47	0 36	46	1 47	0 45	33	1 47	0 40	6	1 49	0 27	46	1 52	0 9
9	17	1 45	0 18	14	1 47	0 37	48	1 47	0 44	33	1 47	0 39	7	1 50	0 27	50	1 52	0 8
10	17	1 45	0 18	15	1 47	0 37	47	1 47	0 45	32	1 47	0 40	7	1 50	0 27	49	1 52	0 8
11	18	1 45	0 18	17	1 47	0 38	48	1 47	0 45	32	1 47	0 39	8	1 50	0 27	50	1 52	0 6
12	17	1 45	0 20	18	1 47	0 40	47	1 48	0 45	30	1 47	0 39	9	1 50	0 26	51	1 52	0 6
13	18	1 45	0 21	17	1 47	0 40	47	1 47	0 45	29	1 47	0 39	10	1 50	0 25	52	1 52	0 5
14	17	1 45	0 21	19	1 47	0 40	48	1 48	0 45	27	1 47	0 39	12	1 50	0 26	52	1 52	0 4
15	16	1 45	0 22	20	1 47	0 41	46	1 47	0 47	26	1 47	0 39	13	1 49	0 25	52	1 52	0 3
16	16	1 46	0 22	22	1 47	0 41	45	1 48	0 45	24	1 47	0 38	16	1 50	0 25	52	1 52	0 3
17	13	1 46	0 23	24	1 47	0 41	44	1 48	0 45	23	1 47	0 38	18	1 50	0 24	53	1 52	0 2
18	12	1 46	0 24	25	1 47	0 41	42	1 48	0 44	22	1 48	0 37	20	1 50	0 23	53	1 52	0 1
19	12	1 46	0 24	27	1 47	0 41	39	1 48	0 44	21	1 47	0 36	22	1 50	0 23	53	1 52	0 1
20	11	1 46	0 25	29	1 47	0 41	36	1 48	+ 44	19	1 48	0 36	24	1 50	0 21	52	1 52	0 0
21	9	1 46	0 26	29	1 47	0 42	35	1 49	0 44	17	1 48	0 35	25	1 50	0 20	51	1 52	−
22	10	1 46	0 27	30	1 47	0 42	35	1 48	0 43	15	1 48	0 34	28	1 50	0 20	52	1 52	0 1
23	10	1 46	0 28	31	1 47	0 42	35	1 48	0 43	13	1 48	0 34	30	1 50	0 18	52	1 53	0 1
24	8	1 46	0 27	31	1 47	0 42	35	1 48	0 43	11	1 48	0 32	32	1 50	0 18	52	1 53	0 1
25	7	1 46	0 28	33	1 47	0 43	36	1 48	0 43	9	1 48	0 31	33	1 50	0 17	52	1 53	0 1
26	6	1 46	0 29	38	1 47	0 43	36	1 48	0 43	8	1 48	0 30	36	1 50	0 17	53	1 53	0 2
27	4	1 46	0 29	37	1 47	0 43	37	1 48	0 42	6	1 48	0 30	39	1 51	0 16	52	1 52	0 2
28	2	1 47	0 29	39	1 47	0 44	38	1 48	0 42	5	1 48	0 29	41	1 51	0 17	54	1 52	0 2
29	1	1 47	0 30	41	1 47	0 43	39	1 48	0 42	3	1 48	0 29	43	1 52	0 16	53	1 52	0 2
30	+ 1	1 47	0 31				39	1 48	0 42	2	1 48	0 29	45	1 52	0 15	53	1 52	0 3
31	− 0	1 47	0 31				41	1 48	0 42				47	1 52	0 14			

Days	July.			August.			September.			October.			November.			December.		
	+	+	−	+	+	−	−	+	−	−	+	+	−	+	+	+	+	+
1	51	1 52	0 4	15	1 52	0 26	31	1 47	0 39	45	1 45	0 41	43	1 44	0 32	7	1 46	0 17
2	53	1 51	0 4	15	1 52	0 25	34	1 47	0 39	43	1 45	0 41	42	1 44	0 31	9	1 46	0 16
3	46	1 51	0 5	16	1 52	0 28	36	1 47	0 40	44	1 45	0 41	41	1 44	0 31	12	1 46	0 16
4	45	1 51	0 6	16	1 52	0 28	38	1 47	0 39	42	1 45	0 41	39	1 44	0 31	14	1 46	0 17
5	41	1 51	0 8	16	1 53	0 29	40	1 47	0 40	41	1 45	0 41	39	1 45	0 31	16	1 46	0 15
6	39	1 51	0 8	17	1 53	0 29	42	1 47	0 40	38	1 45	0 40	36	1 44	0 32	18	1 46	0 14
7	36	1 51	0 10	17	1 53	0 30	44	1 46	0 40	38	1 45	0 40	33	1 44	0 32	18	1 46	0 13
8	34	1 51	0 11	17	1 53	0 30	46	1 45	0 40	38	1 46	0 41	31	1 45	0 32	19	1 46	0 13
9	34	1 50	0 11	18	1 53	0 31	47	1 46	0 40	37	1 46	0 41	28	1 44	0 31	19	1 46	0 11
10	35	1 50	0 13	16	1 53	0 32	48	1 45	0 40	39	1 45	0 41	26	1 45	0 30	22	1 47	0 11
11	30	1 50	0 14	14	1 53	0 32	49	1 45	0 41	39	1 46	0 41	22	1 45	0 30	21	1 47	0 9
12	29	1 50	0 15	13	1 52	0 32	50	1 45	0 41	39	1 45	0 40	22	1 46	0 29	21	1 46	0 9
13	28	1 50	0 15	11	1 52	0 34	50	1 45	0 42	40	1 46	0 40	18	1 45	0 29	21	1 46	0 7
14	27	1 51	0 17	8	1 52	0 34	51	1 45	0 42	40	1 45	0 40	16	1 46	0 28	22	1 46	0 6
15	26	1 51	0 16	5	1 52	0 35	51	1 46	0 42	41	1 45	0 40	15	1 46	0 27	22	1 46	0 5
16	25	1 51	0 19	+ 2	1 51	0 35	51	1 45	0 42	41	1 45	0 39	14	1 47	0 27	22	1 46	0 4
17	25	1 51	0 19	− 1	1 51	0 35	52	1 45	0 43	41	1 44	0 39	13	1 46	0 26	22	1 46	0 2
18	25	1 51	0 20	4	1 50	0 36	51	1 45	0 43	41	1 44	0 39	13	1 46	0 26	22	1 46	0 2
19	26	1 51	0 20	8	1 49	0 36	51	1 45	0 43	42	1 44	0 39	12	1 46	0 25	22	1 46	0 1
20	27	1 51	0 21	11	1 49	0 36	51	1 45	0 43	42	1 44	0 38	10	1 46	0 25	23	1 45	0 0
21	26	1 51	0 21	13	1 49	0 37	52	1 45	0 43	43	1 44	0 38	8	1 47	0 24	23	1 45	−
22	26	1 51	0 22	15	1 49	0 37	53	1 45	0 43	43	1 44	0 37	9	1 46	0 23	24	1 45	0 2
23	24	1 51	0 22	17	1 48	0 37	53	1 45	+ 43	44	1 43	0 36	4	1 46	0 22	24	1 45	0 3
24	23	1 51	0 23	19	1 49	0 38	53	1 45	0 43	45	1 43	0 35	− 1	1 46	0 22	24	1 45	0 3
25	19	1 52	0 24	19	1 48	0 38	52	1 45	0 43	45	1 43	0 35	+ 1	1 45	0 21	24	1 45	0 4
26	18	1 51	0 25	21	1 48	0 39	51	1 45	0 43	45	1 43	0 35	3	1 46	0 20	24	1 45	0 5
27	17	1 51	0 25	22	1 48	0 38	49	1 45	0 42	45	1 43	0 35	3	1 46	0 19	23	1 44	0 6
28	16	1 51	0 25	24	1 48	0 39	48	1 46	0 43	46	1 43	0 35	4	1 45	0 19	22	1 44	0 7
29	14	1 51	0 25	26	1 47	0 38	46	1 46	0 42	47	1 43	0 34	6	1 46	0 19	21	1 44	0 8
30	14	1 52	0 26	28	1 47	0 39	45	1 46	0 42	45	1 43	0 34	8	1 46	0 17	19	1 44	0 9
31	14	1 52	0 27	30	1 47	0 39				44	1 43	0 35				17	1 44	0 10

N. B. *The Equation of Declination for every* 4 *Julian Years adds in the Sun's Paffage from the Equator to the* Solftices ; *but fubtracts in its Paffage from the Solftices to the* Equator. —The Equation of the Sun's Pl. for every 4 Years continually adds.—The Equation of Clock-Time, in *Thirds*, for every 4 Years, adds and fubtracts, alternately. From *Jan.* 1ft, *it adds to* Jan. 30 ;—*fubt. fr. thence to* May 3. *adds fr. thence to* 16 Aug. *fub. fr. thence to* 24 Nov. *adds fr. thence to* 30 Jan.—The Signs printed are for Years forward ; and the contrary Signs ferve for Yrs. back.

SMALL

SMALL EQUATIONS continued, &c. according to M. *De la Caille*.

EQUATION of the SUN's Right Ascension in Time for every four Years forward, serving with a contrary Sign and Years forward, for the *Equation* of the Distance in Time, of the *Section of Aries*, from the Meridian, for finding the Time of Stars passing the Meridian by Addition; being the *Complement* of the SUN's Right Ascension in Time.

N. B. For Years back use the contrary Sign.

Days	Jan.	Feb.	Mar.	Apr.	May.	June	July	August	Sept.	Oct.	Nov.	Dec.
	+	+	+	+	+	+	+	+	+	+	+	+
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
1	7	7	6	6	7	8	9	7	7	7	7	7
11	7	7	6	6	7	8	9	7	7	7	7	7
21	7	6	6	6	7	9	8	7	7	7	7	7

The SUN's apparent Semi-Diameter for every fifth Day, in Degrees and Time, for 1760, or Leap Year.

Days	January. ′ ″ ‴	January. m. s. t.	February. ′ ″ ‴	February. m. s. t.	March. ′ ″ ‴	March. m. s. t.	April. ′ ″ ‴	April. m. s. t.	May. ′ ″ ‴	May. m. s. t.	June. ′ ″ ‴	June. m. s. t.
1	16 20 20	1 10 50	16 17 50	1 8 2	16 11 55	1 5 8	16 3 10	1 4 15	15 55 30	1 5 50	15 49 40	1 8 9
6	16 20 15	1 10 33	16 17 0	1 7 30	16 10 15	1 4 50	16 1 50	1 4 22	15 54 20	1 6 14	15 49 10	1 8 23
11	16 20 0	1 10 12	16 50 55	1 6 55	16 8 55	1 4 34	16 0 35	1 4 34	15 53 10	1 6 38	15 43 45	1 8 33
16	16 19 40	1 9 45	16 14 55	1 6 23	16 7 35	1 4 21	15 59 15	1 4 48	15 52 10	1 7 4	15 48 25	1 8 41
21	16 19 10	1 9 15	16 13 55	1 5 54	16 6 5	1 4 14	15 58 0	1 5 7	15 51 20	1 7 25	15 48 10	1 8 43
26	16 18 40	1 8 42	16 12 50	1 5 26	16 4 50	1 4 12	15 56 40	1 5 28	15 50 35	1 7 48	15 48 0	1 8 42

Days	July. ′ ″ ‴	July. m. s. t.	August. ′ ″ ‴	August. m. s. t.	September. ′ ″ ‴	September. m. s. t.	October. ′ ″ ‴	October. m. s. t.	November. ′ ″ ‴	November. m. s. t.	December. ′ ″ ‴	December. m. s. t.
1	15 47 50	1 8 31	15 50 10	1 6 24	15 56 10	1 4 15	16 4 0	5 4 12	16 12 20	1 6 50	16 18 25	1 10 7
6	15 48 0	1 8 17	15 51 0	1 5 34	15 57 20	1 4 5	16 5 25	1 4 29	16 13 40	1 7 23	16 19 0	1 10 30
11	15 48 15	1 8 0	15 52 50	1 5 10	15 58 40	1 3 57	16 6 45	1 4 46	16 14 45	1 8 0	16 19 30	1 10 45
16	15 48 35	1 7 41	15 52 40	1 4 48	16 0 0	1 3 54	16 8 5	1 5 10	16 15 45	1 8 35	16 20 0	1 10 56
21	15 48 55	1 7 20	15 53 35	1 4 31	16 1 20	1 3 56	16 9 30	1 5 37	16 16 45	1 9 8	16 20 15	1 11 2
26	15 49 25	1 6 55	15 54 45	1 4 17	16 2 50	1 4 1	16 10 50	1 6 8	16 17 40	1 9 40	16 20 20	1 11 3

EQUATION of the *Horizontal* SEMI-DIAMETER of the MOON, to the apparent Semi-diameter of the MOON, in ALTITUDE.

The Horizontal *Semi Diameter* to the Horizontal *Parallax* of the Moon being considered as 15′ to 55′ 40″.

Argument. The Moon's Altitude, and Horizontal Semi-Diameter.

Horizontal Semi-Diameter of the MOON.

☽ Alt.	14′ 40″ +	Dif.	15′ 0″ +	Dif.	15′ 20″ +	Dif.	15′ 40″ +	Dif.	16′ 0″ +	Dif.	16′ 20″ +	Dif.	16′ 40″ +	Dif.	17′ 0″ +	Dif.
°	″ ‴	‴	″ ‴	‴	″ ‴	‴	″ ‴	‴	″ ‴	‴	″ ‴	‴	″ ‴	‴	″ ‴	‴
0	0 0		0 0		0 0		0 0		0 0		0 0		0 0		0 0	
5	1 13	73	1 16	76	1 20	80	1 23	83	1 27	87	1 30	90	1 34	94	1 38	98
10	2 25	72	2 32	76	2 39	79	2 45	82	2 53	86	3 0	90	3 7	93	3 15	97
15	3 36	71	3 46	74	3 56	77	4 7	82	4 17	84	4 28	88	4 39	92	4 51	96
20	4 46	70	4 59	73	5 12	76	5 26	79	5 40	83	5 54	86	6 9	90	6 24	93
25	5 53	67	6 9	70	6 26	74	6 43	77	7 1	81	7 18	84	7 36	87	7 54	90
30	6 58	65	7 17	68	7 37	71	7 57	74	8 17	76	8 38	80	9 0	84	9 21	87
35	7 59	61	8 21	64	8 44	67	9 7	70	9 30	73	9 54	76	10 19	79	10 44	83
40	8 57	58	9 22	61	9 47	63	10 13	66	10 39	69	11 6	72	11 33	74	12 2	78
45	9 51	54	10 18	56	10 46	59	11 14	61	11 43	64	12 13	67	12 43	70	13 14	72
50	10 40	49	11 10	52	11 40	54	12 11	57	12 42	59	13 14	61	13 47	64	14 20	66
55	11 24	44	11 56	46	12 28	48	13 0	49	13 34	52	14 9	55	14 44	57	15 20	60
60	12 4	40	12 37	41	13 11	43	13 48	48	14 21	47	14 57	48	15 34	50	16 12	52
65	12 37	33	13 12	35	13 48	37	14 24	36	15 1	40	15 40	43	16 18	44	16 58	46
70	13 5	28	13 41	29	14 18	30	14 56	32	15 34	33	16 14	34	16 54	36	17 35	37
75	13 27	22	14 5	24	14 42	24	15 21	25	16 0	26	16 41	27	17 22	28	18 5	30
80	13 43	16	14 21	16	15 0	18	15 39	18	16 19	19	17 1	20	17 43	21	18 26	21
85	13 53	10	14 31	10	15 10	10	15 51	12	16 30	11	17 12	11	17 55	12	18 39	13
90	13 56	3	14 34	3	15 13	3	15 54	3	16 35	5	17 16	4	18 0	5	18 43	4

Apparent OBLIQUITIES of the *Ecliptic* and *Equator*, for *January* 1, in the Years following.

1748	23°	28′	20″	1757	23°	28′	21″	1760	23°	28′	24″	1763	23°	28′	18″
1755	23	28	16	1758	23	28	23	1761	23	28	23	1764	23	28	15
1756	23	28	19	1759	23	28	24	1762	23	28	21	1765	23	28	11

Still decreasing (See p. 33) 23 28 20 being the *Mean* Obliquity, according to the *French* Authority.

EXAMPLE. *To find the Moon's* apparent *Semi-Diameter in Altitude, and apparent Altitude of the Moon's Center, from the Horizontal Semi-Diameter 16′ 15″, and apparent Altitude of the Moon's upper Limb, 49° 30′, observed?*

Alt. ☽ 49° 30′ 0″ observed.
— 16 28

49 13 32 Ap. Alt. ☽'s Center, reqd.

Horizontal or true Semi-Diameter 16′ 15″
Under 16′ 20″, and against 49° 30′ Altitude, you find + 13 Equation

Apparent Semi-Diameter ☽ in Altitude 16 28 required.

TABLE of CLOCK-TIME at NOON by the SUN, the SUN's Right Ascension, and his Complement of Right Ascension, or Distance of *Aries* from the *Meridian*, in Time, according to M. *De la Caille*, reduced to *Greenwich* Observatory for 1760.

	JANUARY.					FEBRUARY.					MARCH.				
Days	Clock Time at Noon by the ☉	Dif.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.	Clock Time at Noon by the ☉	D.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time or ♈ fr. Mer.	Clock Time at Noon by the ☉	D.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.
	h. m. s.	s.	h. m. s.	m. s.	h. m. s.	h. m. s.	s.	h. m. s.	m. s.	h. m. s.	h. m. s.	s.	h. m. s.	m. s.	h. m. s.
1	12 4 27	28	18 50 46	4 24	5 9 14	12 14 10	7	21 2 45	4 4	2 57 15	12 12 33	12	22 51 30	3 44	1 8 30
2	12 4 55	27	18 55 10	4 25	5 4 50	12 14 17	6	21 6 49	4 3	2 53 11	12 12 21	14	22 55 14	3 44	1 4 46
3	12 5 22	27	18 59 35	4 24	5 0 25	12 14 23	5	21 10 52	4 1	2 49 8	12 12 7	13	22 58 58	3 43	1 1 2
4	12 5 49	27	18 3 59	4 23	4 56 1	12 14 28	4	21 14 53	4 1	2 45 7	12 11 54	14	23 2 41	3 41	0 57 19
5	12 6 16	26	19 8 22	4 22	4 51 38	12 14 32	4	21 18 54	4 0	2 41 6	12 11 40	15	23 6 22	3 42	0 53 38
6	12 6 42	26	19 12 44	4 23	4 47 16	12 14 36	2	21 22 54	3 59	2 37 6	12 11 25	15	23 10 4	3 42	0 49 56
7	12 7 8	25	19 17 7	4 22	4 42 53	12 14 38	2	21 26 53	3 58	2 33 7	12 11 10	15	23 13 46	3 41	0 46 14
8	12 7 33	25	19 21 29	4 20	4 38 31	12 14 40	1	21 30 51	3 58	2 29 9	12 10 55	16	23 17 27	3 41	0 42 33
9	12 7 58	24	19 25 49	4 21	4 34 11	12 14 41	0	21 34 49	3 57	2 25 11	12 10 39	16	23 21 8	3 41	0 38 52
10	12 8 22	23	19 30 10	4 20	4 29 50	12 14 41	0	21 38 46	3 55	2 21 14	12 10 23	16	23 24 49	3 40	0 35 11
11	12 8 45	23	19 34 30	4 19	4 25 30	12 14 41	1	21 42 41	3 55	2 17 19	12 10 7	17	23 28 29	3 40	0 31 31
12	12 9 8	22	19 38 49	4 20	4 21 11	12 14 40	3	21 46 36	3 55	2 13 24	12 9 50	17	23 32 9	3 39	0 27 51
13	12 9 30	22	19 43 9	4 18	4 16 51	12 14 37	2	21 50 31	3 54	2 9 29	12 9 33	17	23 35 48	3 40	0 24 12
14	12 9 52	21	19 47 27	4 18	4 12 33	12 14 35	4	21 54 25	3 53	2 5 35	12 9 16	17	23 39 28	3 39	0 20 32
15	12 10 13	20	19 51 45	4 17	4 8 15	12 14 31	4	21 58 18	3 53	2 1 42	12 8 59	18	23 43 7	3 38	0 16 53
16	12 10 33	19	19 56 2	4 15	4 3 58	12 14 27	5	22 2 11	3 51	1 57 49	12 8 41	17	23 46 45	3 39	0 13 15
17	12 10 52	19	20 0 17	4 16	3 59 43	12 14 22	6	22 6 2	3 51	1 53 58	12 8 24	18	23 50 24	3 38	0 9 36
18	12 11 11	18	20 4 33	4 15	3 55 27	12 14 16	6	22 9 53	3 49	1 50 7	12 8 6	18	23 54 2	3 39	0 5 58
19	12 11 29	17	20 8 48	4 14	3 51 12	12 14 10	7	22 13 42	3 50	1 46 18	12 7 48	19	23 57 41	3 38	0 2 19
20	12 11 46	17	20 13 2	4 13	3 46 58	12 13 3	7	22 17 32	3 49	1 42 28	12 7 29	18	0 1 19	3 38	23 58 41
21	12 12 3	15	20 17 15	4 12	3 42 45	12 13 56	9	22 21 21	3 48	1 38 39	12 7 11	19	0 4 57	3 38	23 55 3
22	12 12 18	15	20 21 27	4 11	3 38 33	12 13 47	9	22 25 9	3 47	1 34 51	12 6 52	18	0 8 35	3 38	23 51 25
23	12 12 33	14	20 25 38	4 11	3 34 22	12 13 38	9	22 28 56	3 48	1 31 4	12 6 34	19	0 12 13	3 36	23 47 47
24	12 12 47	14	20 29 49	4 10	3 30 11	12 13 29	10	22 32 44	3 46	1 27 16	12 6 15	18	0 15 49	3 39	23 44 11
25	12 13 1	12	20 33 59	4 9	3 26 1	12 13 19	11	22 36 30	3 46	1 23 30	12 5 57	19	0 19 28	3 38	23 40 32
26	12 13 13	13	20 38 8	4 8	3 21 52	12 13 8	11	22 40 16	3 45	1 19 44	12 5 38	19	0 23 6	3 38	23 36 54
27	12 13 26	9	20 42 16	4 8	3 17 44	12 12 57	12	22 44 1	3 45	1 15 59	12 5 19	19	0 26 44	3 37	23 33 16
28	12 13 35	10	20 46 24	4 7	3 13 36	12 12 45		22 47 46		1 12 14	12 5 0	18	0 30 21	3 37	23 29 39
29	12 13 45	10	20 50 31	4 6	3 9 29						12 4 42	19	0 33 58	3 39	23 26 1
20	12 13 55	8	20 54 37	4 4	3 5 23						12 4 23	18	0 37 37	3 39	23 22 23
31	12 14 3		20 58 41		3 1 19						12 4 5		0 41 16		23 18 44

In Leap Year take out for a Day sooner in January and February only.—For 1, 2, 3, Years after Leap Year take out for $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, of a Day sooner in all the Months (*S. p.* 194)

D.	APRIL.					MAY.					JUNE.				
1	12 3 46	18	0 44 54	3 38	23 15 6	11 56 48	7	2 36 10	3 49	21 23 56	11 57 24	8	4 39 0	4 5	19 21 0
2	12 3 28	18	0 48 32	3 38	23 11 28	11 56 41	7	2 39 59	3 50	21 20 1	11 57 32	10	4 43 5	4 6	19 16 55
3	12 3 10	18	8 52 10	3 39	23 7 50	11 56 34	6	2 43 49	3 51	21 16 11	11 57 42	10	4 47 11	4 7	19 12 49
4	12 2 52	18	0 55 49	3 38	23 4 11	11 56 28	6	2 47 40	3 51	21 12 20	11 57 52	11	4 51 18	4 7	19 8 42
5	12 2 34	18	0 59 27	3 39	23 0 33	11 56 22	5	2 51 31	3 52	21 8 29	11 58 3	10	4 55 25	4 7	19 4 35
6	12 2 16	17	1 3 6	3 39	22 56 54	11 56 17	4	2 55 23	3 52	21 4 37	11 58 13	11	4 59 32	4 7	19 0 28
7	12 1 59	17	1 6 45	3 39	22 53 15	11 56 13	4	2 59 15	3 52	21 0 45	11 58 24	11	5 3 39	4 8	18 56 21
8	12 1 42	17	1 10 24	3 40	22 49 36	11 56 9	3	3 3 7	3 54	20 56 53	11 58 35	12	5 7 47	4 8	18 52 13
9	12 1 25	16	1 14 4	3 40	22 45 56	11 56 6	3	3 7 1	3 53	20 52 2	11 58 47	12	5 11 55	4 9	18 48 5
10	12 1 9	17	1 17 44	3 39	22 42 16	11 56 3	2	3 10 54	3 54	20 49 6	11 58 59	11	5 16 4	4 8	18 43 56
11	12 0 52	16	1 21 23	3 41	22 38 37	11 56 1	1	3 14 48	3 56	20 45 12	11 59 10	12	5 20 12	4 9	18 39 48
12	12 0 36	16	1 25 4	3 41	22 34 56	11 56 0	1	3 18 44	3 55	20 41 16	11 59 22	13	5 24 21	4 9	18 35 39
13	12 0 20	15	1 28 45	3 41	22 31 15	11 55 59	1	3 22 39	3 56	20 37 21	11 59 35	12	5 28 30	4 10	18 31 30
14	12 0 5	15	1 32 26	3 42	22 27 34	11 55 58	0	3 26 35	3 57	20 33 25	11 59 47	13	5 32 40	4 9	18 27 20
15	11 59 50	15	1 36 8	3 42	22 23 52	11 55 58	1	3 30 32	3 58	20 29 28	12 0 0	12	5 36 49	4 9	18 23 11
16	11 59 35	14	1 39 50	3 42	22 20 10	11 55 59	2	3 34 30	3 58	20 25 30	12 0 12	13	5 40 58	4 9	18 19 2
17	11 59 21	14	1 43 32	3 42	22 16 28	11 56 1	1	3 38 28	3 58	20 21 32	12 0 25	13	5 45 7	4 9	18 14 53
18	11 59 7	13	1 47 14	3 43	22 12 46	11 56 2	3	3 42 26	4 0	20 17 34	12 0 38	13	5 49 16	4 10	18 10 44
19	11 58 54	14	1 50 57	3 43	22 9 3	11 56 5	3	3 46 26	3 59	20 13 34	12 0 51	13	5 53 26	4 10	18 6 34
20	11 58 40	12	1 54 40	3 44	22 5 20	11 56 8	3	3 50 25	3 59	20 9 35	12 1 4	13	5 57 36	4 10	18 2 24
21	11 58 28	12	1 58 24	3 45	22 1 36	11 56 11	5	3 54 24	4 1	20 5 36	12 1 17	13	6 1 46	4 10	17 58 14
22	11 58 16	12	2 2 9	3 44	21 57 51	11 56 16	4	3 58 25	4 1	20 1 35	12 1 30	13	6 5 56	4 10	17 54 4
23	11 58 4	11	2 5 53	3 45	21 54 7	11 56 20	5	4 2 26	4 2	19 57 34	12 1 43	12	6 10 6	4 9	17 49 54
24	11 57 53	11	2 9 38	3 46	21 50 22	11 56 25	6	4 6 28	4 3	19 53 32	12 1 55	13	6 14 15	4 10	17 45 45
25	11 57 42	10	2 13 24	3 46	21 46 36	11 56 31	6	4 10 31	4 3	19 49 29	12 2 8	13	6 18 25	4 8	17 41 35
26	11 57 32	10	2 17 10	3 47	21 42 50	11 56 37	7	4 14 34	4 3	19 45 26	12 2 21	12	6 22 33	4 9	17 37 27
27	11 57 22	10	2 20 57	3 47	21 39 3	11 56 44	7	4 18 37	4 4	19 41 23	12 2 33	12	6 26 42	4 9	17 33 18
28	11 57 12	8	2 24 44	3 48	21 35 16	11 56 51	7	4 22 41	4 4	19 37 19	12 2 45	12	6 30 51	4 9	17 29 9
29	11 57 4	8	2 28 32	3 49	21 31 28	11 56 58	8	4 26 45	4 4	19 33 15	12 2 57	12	6 35 0	4 8	17 25 0
30	11 56 56		2 32 21		21 27 39	11 57 6	9	4 30 49	4 5	19 29 11	12 3 9	11	6 39 8		17 20 52
31						11 57 15		4 34 54		19 25 6					

TABLE

TABLE of CLOCK-TIME at NOON by the SUN, the SUN's Right Ascension, and his Complement of Right Ascension, or Distance of *Aries* from the *Meridian*, in Time, according to M. *De la Caille*, reduced to *Greenwich* Observatory for 1760.

Days	JULY. Clock Time at Noon by the ☉	Dif.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.	AUGUST. Clock Time at Noon by the ☉	D.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.	SEPTEMBER. Clock Time at Noon by the ☉	D.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.
	h. m. s.	s.	h. m. s.	m. s.	h. m. s.	h. m. s.	s.	h. m. s.	m. s.	h. m. s.	h. m. s.	s.	h. m. s.	m. s.	h. m. s.
1	12 3 20	12	6 43 16	4 7	17 16 44	12 5 47	4	8 47 55	3 53	15 12 5	11 59 33	19	10 43 53	3 37	13 16 7
2	12 3 32	10	6 47 23	4 8	17 12 37	12 5 43	5	8 51 48	3 52	15 8 12	11 59 14	19	10 47 30	3 37	13 12 30
3	12 3 42	11	6 51 31	4 8	17 8 29	12 5 38	5	8 55 40	3 51	15 4 20	11 58 55	20	10 51 7	3 38	13 8 53
4	12 3 53	11	6 55 39	4 7	17 4 21	12 5 33	6	8 59 31	3 51	15 0 29	11 58 35	19	10 54 45	3 37	13 5 15
5	12 4 4	9	6 59 46	4 7	17 0 14	12 5 27	6	9 3 22	3 50	14 56 38	11 58 16	20	10 58 22	3 35	13 1 38
6	12 4 13	10	7 3 53	4 6	16 56 7	12 5 21	7	9 7 12	3 49	14 52 48	11 57 56	20	11 1 58	3 37	12 58 2
7	12 4 23	9	7 7 59	4 6	16 52 1	12 5 14	8	9 11 1	3 49	14 48 59	11 57 36	20	11 5 35	3 36	12 54 25
8	12 4 32	9	7 12 5	4 5	16 47 55	12 5 6	8	9 14 50	3 49	14 45 10	11 57 16	21	11 9 11	3 36	12 50 49
9	12 4 41	9	7 16 10	4 5	16 43 50	12 4 58	9	9 18 39	3 48	14 41 21	11 56 55	20	11 12 47	3 35	12 47 13
10	12 4 50	8	7 20 15	4 5	16 39 45	12 4 49	9	9 22 27	3 47	14 37 33	11 56 35	21	11 16 22	3 36	12 43 38
11	12 4 58	7	7 24 20	4 4	16 35 40	12 4 40	10	9 26 14	3 46	14 33 46	11 56 14	21	11 19 58	3 36	12 40 2
12	12 5 5	8	7 28 24	4 4	16 31 36	12 4 30	10	9 30 0	3 47	14 30 0	11 55 53	20	11 23 34	3 35	12 36 26
13	12 5 13	6	7 32 28	4 3	16 27 32	12 4 20	11	9 33 47	3 45	14 26 13	11 55 33	21	11 27 9	3 36	12 32 51
14	12 5 19	7	7 36 31	4 3	16 23 29	12 4 9	11	9 37 32	3 45	14 22 28	11 55 12	21	11 30 45	3 36	12 29 15
15	12 5 26	5	7 40 34	4 2	16 19 26	12 3 58	13	9 41 17	3 44	14 18 43	11 54 51	21	11 34 21	3 35	12 25 39
16	12 5 31	5	7 44 36	4 2	16 15 24	12 3 45	12	9 45 1	3 44	14 14 59	11 54 30	21	11 37 56	3 35	12 22 4
17	12 5 36	5	7 48 38	4 1	16 11 22	12 3 33	13	9 48 45	3 44	14 11 15	11 54 9	21	11 41 31	3 36	12 18 29
18	12 5 41	4	7 52 39	4 0	16 7 21	12 3 20	14	9 52 29	3 43	14 7 31	11 53 48	21	11 45 7	3 35	12 14 53
19	12 5 45	4	7 56 39	4 0	16 3 21	12 3 6	14	9 56 12	3 43	14 3 48	11 53 27	20	11 48 42	3 36	12 11 18
20	12 5 49	3	8 0 39	3 59	15 59 21	12 2 52	14	9 59 55	3 42	14 0 5	11 53 7	21	11 52 18	3 34	12 7 42
21	12 5 52	2	8 4 38	4 0	15 55 22	12 2 38	15	10 3 37	3 42	13 56 23	11 52 46	21	11 55 54	3 36	12 4 6
22	12 5 54	2	8 8 38	3 58	15 51 22	12 2 23	15	10 7 19	3 41	13 52 41	11 52 25	20	11 59 30	3 35	12 0 30
23	12 5 56	2	8 12 36	3 58	15 47 24	12 2 8	16	10 11 0	3 40	13 49 0	11 52 5	21	12 3 5	3 37	11 56 55
24	12 5 58	0	8 16 34	3 58	15 43 26	12 1 52	16	10 14 40	3 40	13 45 20	11 51 44	20	12 6 42	3 36	11 53 18
25	12 5 58	0	8 20 32	3 57	15 39 28	12 1 36	17	10 18 20	3 40	13 41 40	11 51 24	20	12 10 18	3 37	11 49 42
26	12 5 58	0	8 24 29	3 56	15 35 31	12 1 19	17	10 22 0	3 39	13 38 0	11 51 4	20	12 13 55	3 36	11 46 5
27	12 5 58	1	8 28 25	3 55	15 31 35	12 1 2	17	10 25 39	3 40	13 34 21	11 50 44	19	12 17 31	3 37	11 42 29
28	12 5 57	2	8 32 20	3 55	15 27 40	12 0 45	17	10 29 19	3 39	13 30 41	11 50 25	19	12 21 8	3 37	11 38 52
29	12 5 55	2	8 36 15	3 54	15 23 45	12 0 28	18	10 32 58	3 39	13 27 2	11 50 6	19	12 24 45	3 38	11 35 15
30	12 5 53	3	8 40 9	3 53	15 19 51	12 0 10	19	10 36 37	3 37	13 23 23	11 49 47	19	12 28 23		11 31 37
31	12 5 50		8 44 2		15 15 58	11 59 51		10 40 14		13 19 46					

D.	OCTOBER. Clock Time at Noon by the ☉	Dif.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.	NOVEMBER. Clock Time at Noon by the ☉	D.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.	DECEMBER. Clock Time at Noon by the ☉	D.	☉ Right Ascension in Time.	Dif.	Co. ☉ R. A. in Time, or ♈ fr. Mer.
1	11 49 28	19	12 32 0	3 38	11 28 0	11 43 49	0	14 28 33	3 57	9 31 27	11 49 43	23	16 32 46	4 20	7 27 14
2	11 49 9	18	12 35 38	3 39	11 24 22	11 43 49	1	14 32 30	3 57	9 27 30	11 50 6	25	16 37 6	4 21	7 22 54
3	11 48 51	18	12 39 17	3 38	11 20 43	11 43 50	1	14 36 27	3 59	9 23 33	11 50 31	24	16 41 27	4 21	7 18 33
4	11 48 33	18	12 42 55	3 39	11 17 5	11 43 51	2	14 40 26	3 59	9 19 34	11 50 55	26	16 45 48	4 22	7 14 12
5	11 48 15	17	12 46 34	3 39	11 13 26	11 43 53	4	14 44 25	3 59	9 15 35	11 51 21	25	16 50 10	4 23	7 9 50
6	11 47 58	16	12 50 13	3 40	11 9 47	11 43 57	4	14 48 24	4 1	9 11 36	11 51 46	26	16 54 33	4 23	7 5 27
7	11 47 42	16	12 53 53	3 41	11 6 7	11 44 1	4	14 52 25	4 1	9 7 35	11 52 12	27	16 58 56	4 24	7 1 4
8	11 47 26	16	12 57 34	3 40	11 2 26	11 44 5	6	14 56 26	4 2	9 3 34	11 52 39	27	17 3 20	4 23	6 56 40
9	11 47 10	15	13 1 14	3 41	10 58 46	11 44 11	7	15 0 28	4 3	8 59 32	11 53 6	28	17 7 43	4 25	6 52 17
10	11 46 55	15	13 4 55	3 42	10 55 5	11 44 18	7	15 4 31	4 5	8 55 29	11 53 34	28	17 12 8	4 25	6 47 52
11	11 46 40	15	13 8 37	3 42	10 51 23	11 44 25	8	15 8 36	4 4	8 51 24	11 54 2	28	17 16 33	4 24	6 43 27
12	11 46 25	13	13 12 19	3 43	10 47 41	11 44 33	9	15 12 40	4 6	8 47 20	11 54 30	29	17 20 57	4 26	6 39 3
13	11 46 12	14	13 16 2	3 43	10 43 58	11 44 42	10	15 16 46	4 7	8 43 14	11 54 59	29	17 25 23	4 26	6 34 37
14	11 46 58	13	13 19 45	3 44	10 40 15	11 44 52	11	15 20 53	4 7	8 39 7	11 55 28	29	17 29 49	4 25	6 30 11
15	11 45 45	12	13 23 20	3 44	10 36 31	11 45 3	11	15 25 0	4 8	8 35 0	11 55 57	30	17 34 14	4 27	6 25 46
16	11 45 33	11	13 27 13	3 45	10 32 47	11 45 14	13	15 29 8	4 10	8 30 52	11 56 27	29	17 38 41	4 25	6 21 19
17	11 45 22	11	13 30 58	3 45	10 29 2	11 45 27	13	15 33 18	4 10	8 26 42	11 56 56	30	17 43 6	4 27	6 16 54
18	11 45 11	11	13 34 43	3 46	10 25 17	11 45 40	14	15 37 28	4 10	8 22 32	11 57 26	30	17 47 33	4 26	6 12 27
19	11 45 0	9	13 38 29	3 47	10 21 31	11 45 54	15	15 41 38	4 11	8 18 22	11 57 56	30	17 51 59	4 27	6 8 1
20	11 44 51	9	13 42 16	3 48	10 17 44	11 46 9	16	15 45 49	4 13	8 14 11	11 58 26	30	17 56 26	4 27	6 3 34
21	11 44 42	9	13 46 4	3 48	10 13 56	11 46 25	16	15 50 2	4 13	8 9 58	11 58 56	30	18 0 53	4 27	5 59 7
22	11 44 33	8	13 49 52	3 48	10 10 8	11 46 41	17	15 54 15	4 14	8 5 45	11 59 26	30	18 5 20	4 27	5 54 40
23	11 44 25	7	13 53 40	3 51	10 6 20	11 46 58	18	15 58 29	4 14	8 1 31	11 59 56	30	18 9 47	4 27	5 50 13
24	11 44 18	6	13 57 31	3 50	10 2 29	11 47 16	19	16 2 43	4 15	7 57 17	12 0 26	30	18 14 14	4 26	5 45 46
25	11 44 12	6	14 1 21	3 51	9 58 39	11 47 35	20	16 6 58	4 17	7 53 2	12 0 56	30	18 18 40	4 26	5 41 20
26	11 44 6	5	14 5 12	3 52	9 54 48	11 47 55	20	16 11 15	4 17	7 48 45	12 1 26	29	18 23 6	4 27	5 36 54
27	11 44 1	4	14 9 4	3 52	9 50 56	11 48 15	21	16 15 32	4 17	7 44 28	12 1 55	30	18 27 33	4 26	5 32 27
28	11 43 57	3	14 12 56	3 54	9 47 4	11 48 36	21	16 19 49	4 18	7 40 11	12 2 25	29	18 31 59	4 26	5 28 1
29	11 43 54	2	14 16 50	3 53	9 43 10	11 48 57	23	16 24 7	4 19	7 35 53	12 2 54	29	18 36 25	4 26	5 23 35
30	11 43 52	2	14 20 43	3 55	9 39 17	11 49 20	23	16 28 26		7 31 34	12 3 23	29	18 40 52	4 25	5 19 9
31	11 43 50		14 24 38		9 35 22						12 3 52		18 45 16		5 14 44

Astronomical QUESTIONS (applied to NAVIGATION) answered by the Tables.

QUEST. I. *To find the Instant of a Star passing the Meridian on a given Day?*

RULE. *Add* the Complement of the Sun's R. A. in Time, for a given Place, and Day at Noon (being the Distance in Time of the Section of *Aries* from the Meridian, found in Tables, p. 216, 217.) to the R. A. of the Star, in Time, found in the Catalogue of Stars) and the *Sum* thereof (rejecting 24 Hours when above that Number) will be the near Time, from Noon, of the Star's Passage through the Meridian, required.

To find the Time accurately. Subtract from the near Time, already found, the proportional Decrease, in Time, of the Distance of the Section of *Aries* from the Meridian, to that near Time (the Dist. of the said Section, or Complement of the R. A. of the Sun, having hitherto been only reckoned from the preceding Noon) and the Remainder will be the exact Time of the Star's Passage, required.

EXAMPLE. *Required the correct Time of* Aldebaran, *southing, or passing the Meridian of* Greenwich *Observatory, on* December 30, 1760?

	h	m	s
R. A. of *Aldebaran, Jan. 1, 1750,* by Tab. p. 208.	4	21	36
11 Yrs. Equat. *(fr. Jan. 1750 to Dec. 1760)* at 3s,43 yearly		+	38
R. A. of *Aldebaran, 1760, Dec.* 30d	4	22	14
By *Tab.* p. 217. Comp. R. A. of the Sun, at Noon, on that Day	5	19	11
Near Time of *Aldebaran*'s Southing, fr. Noon	9	41	25 Sum.
NOW, as 24^h *is to* $4^m\ 25^s$ (diurnal Decr. fr. *Aries*, or Comp. R. A. Sun fr. the Merid. fr. 30 to 31 *Dec.* being the same as the diurnal Incr. of R. A. Sun in Col. of Diff. R. A. Sun) *so is* $9^h\ 41^m\ 25^s$, near Time of Southing fr. Noon, *to*		— 1	47 Decr. of Comp. R.A.Sun.
Hence, the correct Time of *Aldebaran*'s Southing, at *Greenwich* Observatory, 1760, *December* 30	9	39	38 P. M. required.

☞ *If the Time of the same Star's Southing was required, at* Antigua, *in the* West Indies, *or at any Place at Sea* 60° West *Longitude from* Greenwich *Observatory, the following Rule must be regarded.*

FIRST, Any *fixed Star* is observed, apparently, to accelerate, or return to the *Meridian* of the same Place *sooner*, each Night, than on the former Night, by the *Increase* of the Sun's R. A. in Time, eastward, *less* the annual or progressive Motion of the Star, in each *diurnal* Revolution of the Earth, eastward. *That is,* each Star returns nearly $3^m\ 56^s$ *sooner* to the same Meridian, in about $23^h\ 56^m\ 4^s$ mean solar Time, *(see p. 29.)* while 360° of the Earth's Equator is revolved to the *eastward*; causing thereby an apparent Motion or Revolution of the whole Heavens, to the *Westward.* And, while 360°, + the Increase R. A. Sun for 24 Hours, is really *revolved Eastward* by the Earth's Equator, and $\frac{50''}{365}$ is *progressively* moved over, easterly, by the *Star*, in 24 Hours, when the *Sun* returns to the same Meridian, then the *Star*, that was the Day before on the Meridian with the *Sun*, *will be got the whole easterly Increase of the Sun's right Ascension, less the easterly Motion of the Star, in that Time, to the westward of the Sun; then due South at Noon.* Consequently, that Star must pass the Meridian, each successive Day, sooner and sooner than the Sun (passing it at Noon) according to the *uniform* diurnal, and *variable* annual Motion of the Earth, *easterly*; till, a little after the Year's End, the *Sun and Star again meet.*

This Interval of Time will be proportional to the *Difference* of the Sun and Star's annual Motions *easterly*, when the *Sun*, that departed from the Star, following him at a slow Rate, again overtakes that *Star* in his annual Circuit, being similar in this Instance, to the *Minute Hand* departing from, and overtaking the *Hour Hand* of a Watch; both moving the same Way, in a Circle, at the same Time, and always meeting after the same *Interval.*

NOW, As the *Longitudes* of the Earth are measured, in Time, by the Sun's Passage from Noon to Noon, from and to the Meridian of the *same Place*, on the Earth's Surface, which Place is daily advanced to the *eastward*, the Difference of the Sun's R. A. in Time, all Places to the westward thereof are advanced to the *eastward* in that Proportion. And since the Motion of a *Star*, the same Way, or eastwardly, is *inconsiderable for a Day*, and as all Stars *accelerate* with the Increase of R. A. of the Sun, in 24 Hours, (while 360° *West Longitude* is advanced by the Earth's easterly Rotation, *more easterly*, by the Dif. Sun's R. A.) therefore, to find the *Acceleration* of any Star, or its sooner southing, in any Place of *West Longitude* from the First Meridian, we have this

GENERAL RULE. As 24^h *West* Longitude, or a Revolution of the Earth, *is to* $4^m\ 25^s$ Sun's R. A. in Time for a Day *more* Motion *advanced* to the eastward, or that Time by which the same Star sooner returns to the same Meridian, *so is* any other *West* Longitude, or 4^h West, the Longitude of *Antigua*, *to* the proportional Time, or 44^s, by which that *Star* is advanced to the Westward, or come sooner to the Meridian of the *Second*, than to that of the *First, Place.* And must be *subtracted* from the Time of the Southing in the first, for the *Time* of Southing in the second, *Place.*

	h	m	s
The Southing of *Aldebaran*, at *Greenwich*, 1760, *Dec.* 30.	9	39	38
At 60° or 4^h West Longitude, proportional Increase R.A. Sun, or Acceleration, sooner			— 44
Aldebaran souths at *Antigua*, 60° West of *Greenwich*, 1760, *Dec.* 30d	9	38	54

N. B. *If the Longitude of a* Second *is* Eastward *of a* first *Place, then any Star souths, for that Longitude, proportionally* later *than at the first Place, as* 360° *East Longitude is to the Sun's Increase of R. A. for a Day, in Time, being the Southing* later *for* 360° *East Longitude, or a Day. This being the Reverse of the* former Rule, *the proportional Quantity must be* added *to the Southing in the first Place.*

QUEST. II. *To find what Star souths nearly at a given Time on a given Day?*

RULE. Find (by Tables, p. 216 and 217) the R. A. Sun in Time, for the Day given; to which add the given Time, reckoned forward from Noon, rejecting 24 Hours, when the *Sum* exceeds that Number. — Seek for the *Sum*, or nearest Time to it, in the *Catalogue of R. A. of Stars*, and against it you will find the Name of the *Star*, nearly southing required?

EXAMPLE. *Required what Star nearly souths, at* $9^h\ 41^m\ 25^s$ *at Night, in* December 30, 1760?

By *Tab. p.* 217. R. A. Sun, at Noon on that Day	18	40	49
Sum	28	22	14
	— 24		
By Tab. p. 208. you find *Aldebaran* against R. A. $4^h\ 21^m\ 36^s$: being the Star required.	4	22	14 remain.

QUEST. III. *To find the Time of Rising and Setting of a given Star, for any Day and Year, at a given Place; the Time of Southing of that Star for the same Place being first found, or given?*

RULE. Subtract and add the Star's Semi-Duration Arc, answerable to its Declination, and the Place's Latitude *(found by the preceding Tables)* from and to the Time of the Star's Southing given, and the *Remainder* and *Sum* will be the respective Times of that Star's Rising and Setting, *required.*

EXAMPLE. *Let it be required to find the Time of Rising and Setting of* Aldebaran, *on* December 30, 1760, *at* Greenwich *Observatory*, Latitude 51° 28′½ N. *and likewise at* Antigua, Latitude 17° 5′ N.?

Aftronomical QUESTIONS (applied to NAVIGATION) anfwered by the Tables.

	h	m	s	
Aldebaran fouths at *Greenwich*-Obfervatory, *Dec.* 30, 1760, found by Queft. I.	9	39	38	P. M.
Declination of *Aldebaran*, at that Time, 16° 0′ 35″ N. *(by Tab. p.* 208.) anfwering to which and Lat. 51° ½ N. The Sem. Duration Arc *(in Pages* 202 *and* 203) is found . . .	7	28	30	∓
Aldebaran rifes, at *Greenwich*, *Dec.* 30ᵈ	2	11	8	Aftern.
Sets	17	8	8	
1760, *Dec.* 31ᵈ	5	8	8	Morn.

	h	m	s	
Aldebaran fouths at *Antigua*, found by Queft. I. *Dec.* 30ᵈ.	9	38	54	P. M.
Sem. Duration Arc anfwering to *Lat.* 17° N. and Decl. 16° N. *(in p.* 200) is found . .	6	22	0	∓
Aldebaran rifes at *Antigua*, *Dec.* 30ᵈ	3	16	54	Aft.
Sets	16	0	54	
1760, *Dec.* 31.	4	0	54	Morn.
	required.			

QUEST. IV. *To find the Time of Sun Rifing and Setting in any Place, for any Day of the Month, and Year given?*

RULE. Subtract and add the Semi-diurnal Arc, anfwerable to the Latitude of the Place and Sun's Declination, for the Day and Year given, *from* and *to* 12 Hours, or Noon, and the *Remainder* and *Sum* will be the refpective Times of Sun Rifing and Setting, required.

EXAMPLE. *To find the Time of* Sun-Rifing *and* Setting, *on* April 15, 1759, *at* Greenwich-*Obfervatory, and likewife at* Antigua, *in the* Weft-Indies?

	h	m	s	
Sun fouths, in all Places . .	12	0	0	
Apr. 15, 1759, 3d Yr. after Lp. (in p. 194) ☉'s Decl. ¼ Day fooner, is found, accordᵍ to ♈ 1,7269, to be 9° 45′ 51″, N. anfwerable to which, and Lat. 51° ½ N. *(in Pages* 202 *and* 203) the Semi-diurnal Arc, is found	6	53	30	∓
Sun rifes at *Greenwich*, 1759, *Apr.* 15ᵈ	5	6	30	allowᵍ for
Sets	6	53	30	Refractⁿ.

N. B. *The Semi-diurnal Arc in Hours, &c. is always the Time of Sun-Setting.*

	h	m	s	
Noon . . .	12	0	0	
Anfwerable to 9° 45′ N. Decl. Sun and Lat. 17° N. (in p. 200) Semi-diurnal Arc is found	6	14	30	—Setting
At *Antigua*, 1759, *April* 15ᵈ	5	45	30	Rifing.
	required.			

QUEST. V. *To find the Sun's* Amplitude *of Rifing and Setting from the* Eaft *or* Weft *Points of the Compafs, according to any Latitude and Declination of the Sun given; for determining the* magnetical *Variation of the Compafs?*

RULE. Under the given Latitude N. or S. from Page 204 to 207, at the Top of the Pages, and againft the given Declination of the Sun, N. or S. on the Side of a Page, at the Angle of Meeting, you have, at Sight, the Number of *Degrees and Minutes of Amplitude Northerly* from E. or W. Lat. N. but *Southerly* Lat. South, in the firft Half Page. Alfo the *Degrees and Minutes of Amplitude Southerly*, from E. and W. Lat. N. but *Northerly* Lat. South, in the fecond half Page. By which true Amplitude of the Tables compared with the *magnetical* Amplitude, found by the *Azimuth*-Compafs, at the Sun's Rifing or Setting, (Refraction being allowed for in the Tables) the *Difference*, or *magnetical* Variation will be known: the *Excefs* or *Defect* of Magnetical Amplitude being the *Way* of Variation.

EXAMPLE I. *Required the Sun's Amplitude of Rifing and Setting for Latitude* 20° N. *and Declination* 20° *South?*

In the fecond half Page 205, under 20° N. Lat. and againft 20° S. Declination, (the inferior Decl. refpecting the fuperior Lat. right up and down in the fame Line) ftands 21° 8′ Amplitude Southerly from E. or W. required. This true Amplitude being compared with the magnetical Amplitude, the Difference will be the magnetical Variation of the Compafs, required.

EXAMPLE II. *Required the Sun's Amplitude of Rifing and Setting for Latitude* 44° *S. and Declination* 12° *South?*

In the firft half Page 206, under S. Lat. 44° and againft 12° S. Declination, ftands 17° 20′ Amplitude Southerly from E. or W. required; which being compared with the magnetical Amplitude, obferved, the magnetical Variation of the Compafs (being the Difference) will be known.

N. B. *The fame Method is to be obferved in determining the Amplitudes of Rifing and Setting of the fixed Stars, of given Declination, when the Latitude of the Place is given. By which Stars the magnetical Amplitude may be obferved, and thence, the magnetical Variation of the Compafs is found; being the Difference of thefe two Amplitudes.*

QUEST. VI. *To find the Length of the longeft Day and Night in any Latitude, whofe Complement is lefs than the Sun's greateft N. or S. Declination?*

WHEN the Complement of the Latitude N. or S. is refpectively equal to the Sun's greateft Declination N. or S. *viz.* 23° 28′ 30″ (the Lat. being then 66° 31′ 30″) and the *Meridian Altitude* always equal to the Sum of the Comp. Lat. and Sun's Declination to the Pole of the fame Name, which Altitude is always equal the *Depreffion* at Midnight) it is evident, that on that Day, the Sun does *not fet*; but touches the Edge of the Horizon at the North Part of the Meridian, oppofite to Noon; and then afcends to the South Part of the Meridian at Noon; whofe Altitude, on that Day, is *Comp. Lat.* + 23° 28′ 30″ *North Declination,* and the longeft Day there, is juft 24 Hours.—*Therefore*, in all Places, where the *Complement of Latitude is lefs than the Sun's greateft Declination*, on that very Day when the Sun's Declin. is equal to the Complement of the Latitude, the Sun *will not fet*, but touch the Horizon in the oppofite Part of the Meridian to 12 at Noon, *(as on the longeft Day in Latitude* 66° 31′ 30″) and the Day will be there juft 24 Hours. In the Sun afcending from which Declination *(the fame with the Complement of Latitude)* to the greateft Declination, and returning back to the fame Declination again, the *longeft Day* in that Latitude will be meafured; and may be determined at Sight, *univerfally)* by our *Solar Ephemeris* from p. 194 to 196, according to what the Sun's Declination is; being of the *fame Name with, and equal to the Complement of Latitude.*

EXAMPLE. *Suppofe the Latitude to be the North Cape* 71° 25′, *in which the longeft Day is required.*

Here the Complement of Latitude = 18° 35′ = Sun's *Declination* North, anfwering to *May* 13, *and July* 29, N. Style, which *Interval* is the longeft Day in that Latitude *required.*

Astronomical QUESTIONS (applied to NAVIGATION) answered by *Spherical* Proportion *and* Logarithms.

I. Question. *To find the* Sun's *present Declination from his Place in the Ecliptic* (♊ 2ˢ 20° 19′ 40″) *and his greatest Declination* (23° 28′ 30″) *given?*

PROPORTION.				*Logarithms.*
As Radius				10.0000000
To Sine of the Sun's Long. from ♈	80°	19′	40″	9.9937822
So Sine gr. Declination	23	28	30	9.6002636
To Sine present Decl. N. required	23	7	18	9.5940458

N. B. In the above Proportion, or *Rule*, the Sun's *Longitude* is always taken from the next equinoctial Point, *Aries*, or *Libra*. Consequently, if the Sun's Place is under 180°, in any of the first six Signs, (*Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra*) the Declination will be North. If above 180°, in the last six Signs (*Scorpio, Sagittary, Capricorn, Aquarius*, and *Pisces*) the Declination will be *South*.—This Question is very useful in Navigation.

II. Question. *To find the Sun's Longitude from* Aries, *or* Libra, *his present Declination* N. *or* S. *being given?*

LET the given Declination be 23° 7′ 18″ N.

Converse of the former PROPORTION.

As Sine greatest Declination . . .	23°	28′	30″ . . co.	0.3997364
To Sine present Declination N. or S.	23	7	18 . . .	9.5940458
So Radius	90	0	0 . . .	10.0000000
To Sine ☉'s Lon. fr. ♈, or ♎, reqd.	80	19	40	9.9937822

N. B. This Question is of Use in Astronomical Observations.

III. Question. *To find the Sun's Right Ascension from his Place in the Ecliptic,* ♊ 20° 19′ 40″, *given?*

PROPORTION.				
As Radius				10.0000000
To Tang. Sun's Long. fr. ♈ . . .	80°	19′	40″	10.7684433
So Cos. greatest Declination	23	28	30	9.9624801
To Tan. Sun's R. A. from ♈, required	79	28	25	10.7309234

☞ When the Sun's Place is in the 1st *Quadrant* of the Ecliptic, in ♈, ♉, ♊, then the 4th *proportional* Arch, is the Sun's right Ascension from *Aries*. If his Place is in the 2d *Quadrant*, ♋, ♌, ♍, then the 4th proportional Arc of right Ascension subtracts from 180, for the right Ascension from *Aries*. When in the 3d *Quadrant*, ♎, ♏, ♐, the 4th proportional Arc is the right Ascension from ♎, and adds to 180° for right Ascension from *Aries*. And when the Sun is in the 4th or last *Quadrant*, ♑, ♒, ♓, the 4th proportional Arc, subtracts from 360°, for the right Ascension from *Aries*.

IV. Question. *To find the Sun's Place in the Ecliptic from the Sun's right Ascension* 79° 28′ 25″ *from Aries, given?*

Converse of the former PROPORTION.

As Cosine gr. Declination . . .	23°	28′	30″ co.	0.0375199
To Tan. Sun's R. A. from *Aries* . .	79	28	25	10.7309234
So Radius	90	0	0	10.0000000
To Tang. Sun's Long. fr. ♈, reqd.	80	19	40	10.7684433

N. B. In the above Proportion, the Tangent of right Ascension must be taken for the Degrees of right Ascension from *Aries*, or *Libra*, or nearest equinoctial Point, by which the correspondent Longitude from either of those Points may be easily determined, as above.

V. Question. *To find the Sun's true Amplitude of Rising or Setting, the Latitude of the Place,* Greenwich, 51° 28′ 30″, N. *and the Sun's Declination, at Rising or Setting,* 23° 5′ 18″, N. *being given?*

PROPORTION.				*Logarithms.*
As Cosine Lat.	51°	28′	30″	9.7943877
To Radius	90	0	0	10.0000000
So Sine Sun's Dec. at Rising or Setting, N.	23	7	18	9.5940458
To Sine Sun's Amplitude N. required. . .	39	5	3	9.7996581

N. B. The *Amplitude* is always of the same Name with the Sun's Declination in any Latitude N. or S.

VI. Question. *To find the Time of true Sun Rising and Setting before and after Six, by the ascensional Difference, with the Length of Day and Night, the Latitude of the Place* 51° 28′ 30″ N. *and Sun's Declination, (at Rising or Setting)* 23° 7′ 18″ N. *being given?*

PROPORTION.				
As Radius	90°	0′	0″	10.0000000
To Tan. Latitude	51	28	30	10.0990059
So Tan. Declination N.	23	7	18	9.6304107
To Sine Ascensional Dif. required . .	32	25	58	9.7294166

N. B. *The Sun rises before* Six, *when the Declination is of the* same Name *with the elevated* Pole; *but after Six, when of the* contrary *Name, by this* Ascensional *Difference turned into* Time; *allowing* 15° *to an Hour.*

° ′ ″ = h m s

32 25 58 = 2 9 44 by *Rule*, p. 167.
+ 6

Semi-diurnal Arc	8	9	44	Sun sets.
Comp. to 12ʰ. . .	3	50	16	Sun rises.
Doub. T. Setting . .	16	19	28	Length of Day.
Comp. to 24, Doub. Rising . .	7	40	32	Length of Night.

As double the Time of Sun Setting gives the Length of the Day, so double the Time of Sun Rising gives the Length of the Night.

VII. Question. *To find the oblique Ascension or Descension of the* Sun, *his Declination (at Rising or Setting)* 23° 7′ 18″ N. *and Latitude of the Place,* 51° 28′ 30″ N. *being given?*

Find the R. A. Sun from ♈, by III. Question . . 80° 19′ 40″

The Ascensional Dif. by VI. Question 32 25 58 ∓

Oblique Ascension . . 47 53 42 } reqd.
Oblique Descension . 112 45 38 }

N. B. When the *Latitude* and Sun's *Declination* are both of the *same* Name, N. or S. the Ascensional Difference *subtracts* from the R. A. for the *oblique Ascension*, and *adds* thereto for the *oblique Descension*. But,

When the Latitude and Sun's Declination are of a *different* Name, (N. and S.) the Ascensional Difference *adds* to the right Ascension for the *oblique Ascension*; and *subtracts* therefrom for the *oblique Descension*.

If the *Ascensional* Difference exceeds the right Ascension, you must add 360° to the right Ascension, and then subtract the *Ascensional* Difference therefrom.

Or, if right Ascension, and *Ascensional* Difference *added*, exceed 360°, the *Excess* will be the oblique Ascension, or Descension, according to the above *Rules*, or the following *Scheme*.

Decl.

Astronomical QUESTIONS (applied to NAVIGATION) answered by *Spherical* PROPORTION and LOGARITHMS.

Decl. and Lat. *same Name*	R. A.	— / +	*Ascens. Dif. for the*	*oblique Ascension.* / *oblique Descension.*
Decl. and Lat. *diff. Name*	R. A.	+ / —	*Ascens. Dif. for the*	*oblique Ascension.* / *oblique Descension.*

VIII. QUESTION. *To find the Semi-diurnal or Semi-nocturnal Arc of the* Sun, or Star, *the Latitude of the Place* 51° 31′ 30″ N. *and Declination* 23° 7′ 18″ N. *being given?*

PROPORTION.		Logarithms.
As Radius		10.0000000
To Tang. Lat.	51° 31′ 30″	10.0990059
So Tang. Decl. same Name with Lat.	23 7 18	9.6304107
To Cos. Semi-nocturnal Arc required	57 34 2	9.7294166

Turned into Time = $3^h\ 50^m\ 16^s$ as before; being the Time of Sun-Setting; whose Complement to 12^h, or $8^h\ 9^m\ 44^s$ is the Time of true Sun Rising.

☞ *Hence the ascensional Difference and the Semi-nocturnal Arc are always the Complement of one another to* 90°, *when the Latitude and Declination are of the same Name. When they are of a different Name, the foregoing Proportion finds the Semi-diurnal Arc of Sun or Star, which Arc, and the* ascensional *Difference are then Complements of one another to* 90°.

IX. QUESTION. *To find the Time of apparent Rising and Setting of the Sun, or of the Moon, a Star, or Planet, from the Meridian, the Declination of either, at that Time, and Height of the Pole, being given?*

Example. Suppose the Latitude *London,* 51° 32′ N.
Sun's Declination at Rising 17 32 N.

RULE. Add 90° 33′ 0″, Sun or ✱'s Zenith Dist. at Ris. or Setting,
Compl. Pole's Height,
And Dist. of *Sun* or *Star* from the Pole.

(which last Distance is equal 90° . . *more,* or *less,* the Declination, according as the Pole is of . . . *dif.* or *same* . . . Name with the Declination N. and S.)

Take ½ *Sum* of these 3 Sides of a spherical Triangle. From which *half* take the Comp. Pole's Height; calling what's left the *1st Remainder.*

From the *same half* take the Sun or Star's Distance from the Pole; calling what's left the *2d Remainder.*

Add the Log. Sines of these *1st and 2d Remainders,* and *double* the Log. of *Radius.*

From which *Sum,* subtract the *Sum* of the Log. Sine of the Comp. of Pole's Height, and Log. Sine of the Distance of the *Sun* or *Star* from the Pole: — *Half* of the last Remainder will be the Log. *Sine* of half the Sun or Star's angular Distance from Noon or the Meridian, at Rising or Setting; which doubled, and reduced into Time, will therefore be the *true Interval* between the *apparent* Rising and Setting of the *Sun,* or *Star,* and the Time of their *passing the Meridian,* when the Declination and Latitude of the Place are of the *same* Denomination. But, if they are of *different* Denomination, the Difference between the said doubled Arc, reduced into Time, and 12 Hours, will be the *Interval* required.

Sun's Zenith Distance	90° 33′	*Side op.* ∠ *req.*
Comp. Pole's Height	38 29	*Sides including* ∠ *required.*
Dist. Sun from Pole	72 28	
Sum	201 30	
From . . . . Half	100 45	

Take Comp. Pole's Height	1. Rem. 62 16	Log. S.	9.9470036
Take Dist. Sun fr. Pole	2. Rem. 28 17	Log. S.	9.6756245
		Doub. Log. Rad.	20.0000000
From . . Sum			39.6226281

N. B. *If a Star, or Planet, had the given Declination, at Rising, then the Semi-diurnal Arc,* 114° 25′ 54″ *is turned into Time, or Semi-Duration Arc, thus.*

		Logarithms.
Log. S.	38° 29′	9.7939907
Log. S.	72 28	9.9793398
Take . . .	*Sum*	19.7733303
	Rem.	19.8492976
57° 12′ 57″	*Half*	9.7733305

As 360° is to the Interval of Time, betwixt two next Passages, thro' the same Meridian, so is 114° 25′ 54″ to the Semi-Duration Arc, *required.* Which subtr. from, and added to, the Time of the Star or Planet's *Southing,* that Day, will give the Time of Rising and Setting, *required.*

Doub. 114 25 54 = $7^h\ 37^m\ 44^s$ Sun sets.
12
4 22 16 Sun rises. *required.*

See p. 167. for turning Degrees, &c. into Time, *arithmetically.*

X. QUESTION. *To find the Time of the Day, from the Sun's Declination, his true Altitude, and Latitude of the Place given?*

RULE. Is *exactly* the same as for answering the preceding Question, in finding the Time of *apparent* Sun-Rise, *except,* that instead of 90° 33′, (the Sun's Zenith Distance *apparent*) you must use the Compl. of the Sun's Altitude observed, after Refraction is allowed for by *Tab.* p. 21.

Example. The Sun's Altitude was observed, at *Sea,* on *July* 18, 1757, just 146° 9′ (or $9^h\ 44^m$ Diff. of Time) eastward of *Greenwich Observatory,* at about 9 in the Forenoon, to be 47° 48′ 47″, the *Refraction* then being 47″, reduces it to 47° 48′ true Altitude. The Sun's Declination, about that Time, was 21° 6′ N. by an *Ephemerides* (it being then about *July* 17, $11^h\ 16^m$ Night, at *Greenwich*) and the Latitude of the Place of Observation 40° 18′ N. required the *exact* Time, at the Place of Observation, and likewise at *Greenwich?*

Comp. Sun's Alt.	42° 12′	Side op. ∠ req.
Comp. Lat.	49 42	Sides including the ∠ req.
Sun from the Pole	68 54	
Sum	160 48	
From . . . Half	80 24	

Take Com. Lat.	1. *Rem.* 30 42	Log. S.	9.7080323
Take Sun's Dist. fr. Pole	2. *Rem.* 11 30	Log. S.	9.2996553
		Doub. Log. Rad.	20.0000000
		From . . . *Sum*	39.0076876
		Log. S. 49° 42′	9.8823357
		Log. S. 68 54	9.9698600
		Take . . . *Sum*	19.8521957
		Rem.	19.1554919

Otherwise.

	Logarithms.
1. Rem. L. S.	9.7080323
2. Rem. L. S.	9.2996553
L. S. 49° 42′ co.	0.1176643
L. S. 68 54 co.	0.0301400
Sum	19.1554919
½	9.5777459

22° 13′ 25″ . . . *Half* L. S. . . . 9.5777459
Double 44 26 50 = $2^h\ 57^m\ 47^s$ T. fr. *Noon.*
12

At Place of *Observation, July* 18d 9 2 13 Forenoon.
Dif. Meridians — 9 44 0 sooner at *Greenwich.*

At *Greenwich, July* 17d 11 18 13, Night
Times *required.*

N. B. *The Time at* Greenwich Observatory, *or any Place for which Meridian an Ephemerides is made, is sooner than the Time of all Places to the* Eastward, *and* later *than the Time of all Places to the* Westward *of that first* Meridian, *by the* Difference *of these Meridians in Time, and the contrary.*

Astronomical QUESTIONS (applied to NAVIGATION) answered by *Spherical* PROPORTION and LOGARITHMS.

And therefore the Declination of the Sun, Moon, *or a* Planet, *at the Time and Place of Observation,* E *or* W, *of the first Meridian, must be found to the correspondent Time, at the* first *Meridian by an* Ephemerides, *proportioned to that* Interval *of Time, betwixt the two next Noons, for which those Declinations, are in the said* Ephemerides *respectively given.*

XI. QUESTION. *To find the Sun or Star's true Altitude at a given Time of the Day,* 2h 57′ 47″ *from Noon, or the Meridian, an Arc of* 44° 26′ 50″; *the Sun's Declination at that Time being* 21° 6′ N. *and the Latitude of the Place* 40° 18′ N.

PROPORTION.				*Logarithms.*
As Radius				10.0000000
To Sine Complement Arc from Noon	44°	26′	50″	9.8536348
So Tangent Complement Latitude ..	40	18	0	10.0715726
To Tangent of an Arc X	40	5	26	9.9252074
☉ from the Pole	68	54	0	
To Sine Complement Arc Y Dif.	28	48	34	9.9426168
As Sine Complement Arc X	40	5	26 co.	0.1163229
So Sine Pole's Height	40	18	0	9.8107631
To Sine Sun's Altitude required	47	48	0	9.8697028

N. B. *Arc X subtracts from the Sun's Distance from the Pole for the Arc Y, when the Time from Noon, or the Meridian, is less than* 6h *or* 90°, *but adds to the Sun's Distance from the Pole, for the Arc Y, when the Time from the Meridian is greater than* 6h *or* 90°.

☞ The above Proportions find the Side of any *Spherical Triangle* opposite to a given Angle, included between two given Sides.

Thus, *As Radius to Sine Complement* ∠ *included,*
So Tangent less including Side to Tangent Arc X.

Subtract this Arc X from the other including *Side*, when the included ∠ is less than 90°, but add it thereto, when the included ∠ is greater than 90°, calling the Arc of *Difference* or of the *Sum*, Y.

Then say, *As Sine Complement X is to Sine Complement Y,*
So is Sine Complement less including Side to the Sine Complement of the Side opposite the included Angle.

XII. QUESTION. *To find the apparent Amplitude of Rising or Setting of the Sun, Moon, a Star, or Planet, the Declination of either at that Time, and the Latitude of the Place, being given?*

Example. Sun's Declination at that Time is 23° 7′ 18″ N. and Latitude 51° 28′ 30″ at *Greenwich*.

Here are given ☉ fr. Pole	66°	52′	42″	Side op. ∠ required.	
☉ Zenith Distance . .	90	33	0	Sides including	
Complement Latitude . .	38	31	30	∠ reqd. *viz.* Azim. first.	
Sum	195	57	12		
From . . Half	97	58	36		
Take ☉ Zenith D. 1 rem.	7	25	36	Log. S.	9.1114545
Take Comp. Lat. 2 rem.	59	27	6	Log. S.	9.9351046
Log. S.	90°	33′	0	co.	0.0000200
Log. S.	38	31	30	co.	0.2056123
				Sum	19.2521914
Log. S.	25°	0′	33″	Half	9.6260957
Doubled	50°	1′	6″	∠ of *Azimuth* fr. N.	
	90	0	0		
Apparent Amplitude	39	59	44	fr. the East Northerly.	
True Ampl. by V. Qu.	39	5	3	Northerly.	
Dif. bet. true and app.		54	41	in this Case.	

The *apparent* Amplitude being so much the more *Northerly*.

N. B. *When the Latitude and Declination are of the same Name, the foregoing Proportion finds the Azimuth from the North Point of the Horizon; but if the Latitude and Declination are of contrary Names, the foregoing Proportion finds the Azimuth from the South Point of the Horizon, which Azimuth-Angle being taken from* 90°, *will leave the Amplitude to the Northward or Southward of the East, or West Point of the Horizon accordingly, required.*

XIII. QUESTION. *To find the Azimuth of the Sun, Moon, or a Planet, from the Declination* 20° 30′ N. *Altitude* 47° 30′, *and Latitude* 51° 32′ *given; the Declination being for the Time of the Altitude?*

					Logarithms.
Here are given Sun fr. Pole	69°	30′	Side op. ∠ required.		
Complement Lat.	38	28	Sides includg.	L.S. co.	0.2061683
Complement Alt.	42	30	∠ required.	L.S. co.	0.1703167
Sum	150	28			
From . . Half	75	14			
Take Co. Lat. 1 rem.	36	46		Log. Sine	9.7771060
Take Co. Alt. 2 rem.	32	44		Log. Sine	9.7329803
				Sum	19.8865713
Log. S. 61° 21′ 6″				Half	9.9432856
Doubled 122 42 12				Sun's Azimuth fr. North required.	

N. B. *When the Declination and Latitude are of different Names this Rule finds the Azimuth from the South, required.*

XIV. QUESTION. *To find the Latitude from the Declination* 20° 30′ N. *Altitude* 47° 30′, *and Azimuth of the Sun or any Star* 112° 42′ 12″ *from the* N. *given?*

PROPORTION.				
As Radius, or Sine	90°	0′	0″	10.0000000
To Tan. Zenith Distance	42	30	0	9.9620525
So Cos. Azimuth from N. . . .	122	42	12	9.7326264
To Tan. Arc. X	26	20	21	9.6946789
Now, As Sine Altitude	47	30	10 co.	0.1323691
To Cos. Arc X	26	20	21	9.9523969
So Sine Declination . . .	20	30	0	9.5443253
To Cos. Arc Y.	64	48	21	9.6290913
Arc X . . .	—26	20	21	
Complement Latitude . .	38	28	0=Y—X.	
Latitude *required*	51	32	0 as before.	

N. B. *If the Observation be made between* 6 *in the Morning and* 6 *in the Afternoon, on the same Day, at the same Time the Azimuth is less than* 90° (*which generally happens when the Declination and Latitude are of different Name, and the Azimuth is taken from the South*) *then the Sum of the Arches* X *and* Y, *will be the Complement of the Latitude, whose Complement will be the Latitude required. But if the Azimuth from North is less than* 90°, *and Declination and Latitude of the same Name, the Sum of* X *and* Y *will be the Complement of Latitude.*

N. B. The foregoing Proportions, answering the XIV Question, find the third Side of any Spherical Triangle, when the other two Sides and an Angle opposite to one of those Sides are given.

Thus, As Radius is to Tangent of the less Side, so is Cosine of the given Angle, (opposite to the greater Side) to Tangent of an Arc X, Part of the Base without or within the Triangle, where a Perpendicular falls, from the End of the longer Side upon the required Side continued, or upon it.

Again,

Astronomical QUESTIONS (applied to NAVIGATION) answered by *Spherical* PROPORTION and LOGARITHMS.

Again, As Cosine less Side is to the Cosine of the Arc X, (without or within the Triangle, where a Perpendicular falls, *according as the given Angle opposite to the greater Side, is more or less than* 90°) So is the Cosine of the longer Side, *To* the Cosine of the *whole Base*, or *greater* Segment.

Where it must be noted that Y *is the whole Base found, when the given* ∠ *exceeds* 90°, *and then* X, *the external Segment thereof,* subtracts *from it, for the Length of the required Side, or Segment. But if the Angle given is less than* 90°, *then* Y *is the greater and* X *the less Segment of the required Base, whose Sum is therefore the whole Base or Side required.*

These Things are demonstrable from *Spherical* Trigonometry, to which we refer the Reader if he requires further Satisfaction, the Truth of the Rules, as here applied to Practice, being sufficient for our Purpose.

XV. QUESTION. *To find the Distance, in Time, of the Sun, or a Star, from the Meridian, the Azimuth from the North* 122° 42′ 12″, *Declination* 20° 30′ N. *and Altitude* 47° 30′ *at that Time, being given?*

PROPORTION.

				Logarithms.
As Cosine Declination	20°	30′	0″ co.	0.0284124
To Sine Azimuth from North	122	42	12	9.9250435
So the Cosine Altitude	47	30	0	9.8296833
To Sine angular Dist. from the Merid.	37	22	5	9.7831392

XVI. QUESTION. *To find the Azimuth of the Sun or a Star, from the Latitude* 51° 32′ N. *Declination* 20° 30′ N. *and Distance at the same Time of the Sun or Star from the Meridian,* 37° 22′ 5″, *being given?*

RULE. Take the *Sum* and *Difference* of the Complement of the Latitude and Distance of the Sun, or Star, from the Pole.

38° 28′ Complement Latitude
69 30 Sun or Star's Distance from the Pole.

Sum 107 58
½ 53 59

Dif. 31 2
½ 15 31

Then say by PROPORTION.

As Cosine ½ Sum	53°	59′	0″ co.	0.2306075
To Cosine ½ Diff.	15	31	0	9.9838755
So Cotang. ½ Angular Dist. from Merid.	18	41	2	10.4708675
To Tang. Arc. X	78	20	22	10.6853505
Again, As Sine ½ Sum	53	59	0 co.	0.0921342
To Sine ½ Diff.	15	31	0	9.4273541
So Cotang. ½ ∠ Dist. fr. Mer.	18	41	2	10.4708675
To Tang. Arc Y.	44	21	50	9.9903558
X=	78	20	22	

Y+X=122 42 12 Azim. fr. N. reqd.
X−Y= 33 58 32 ∠ op. co. Lat.

N. B. In the above Proportions, when ½ Sum of the Complement of Latitude and Sun or Star's Distance from the Pole exceed, or is less than 90°, then X is greater or less than 90°.

The Sum of the Arcs X *and* Y *is the Angle of Azimuth from the North, and the Difference of* X *and* Y *is the other or less Angle, included by the Distance of the Sun or Star, from the Zenith and Distance of the same, from the Pole, when the Sun or Star's Zenith Distance is less than their Polar Distance, the other Side of the Spherical Triangle being the Complement of Latitude.* When the Polar is less than the Zenith Distance from the Sun or Star, then the Difference of X and Y is the Azimuth, and the Sum of X and Y the other alternate ∠, opposite the Pole's Distance from the Zenith.

☞ The foregoing Proportions find the ∠s of any Spherical Triangle opposite to two given Sides, including a given Angle, and therefore find the Angle of Position in Sailing by the Arch of a great Circle, continually varying that Course, cross the Meridians, betwixt two Places of *given Latitudes*, and given *Difference* of Longitude: The Polar Distances of those Places, and Angle betwixt them, being also given. *See Mr.* EMERSON'S *Navigation*, p. 28.

XVII. QUESTION. *To find the Latitude of the Place from the Sun's Declination* 23° 7′ 18″ N. *and the Time of the Sun's Rising then* 3^h 50^m 16^s, *being given.*

RULE. Turn the Time of Sun-Rising before or after Six into Degrees (by p. 28) which is called the *Ascensional* Difference.

Thus, 6^h 0^m 0^s
3 50 16

2 9 44=32° 25′ 58″

Then say, by this PROPORTION.

				Logarithms.
As Radius				10.0000000
To Cotang. Declination N.	23°	7′	18″	10.3695893
So Sine Ascensional Difference	32	25	58	9.7294166
To Tangent of Latitude required	51	28	30	10.0990059

XVIII. QUESTION. *To find the Latitude of the Place from the Sun's Declination,* 23° 7′ 18″ N. *and Amplitude* 39° 5′ 3″, *being given?*

PROPORTION.

As Sine Amplitude from E. or W.	39°	5′	3″	9.7996581
To Radius				10.0000000
So Sine Declination N.	23	7	18	9.5940458
To Cosine Latitude required	51	28	30	9.7943877

N. B. *These Questions of Data at the Horizon, are easiest for finding the Latitude of Places; because they come under the Form of a Right angled Spherical Triangle: whereas Questions concerning Altitude of the Sun or Star, betwixt Rising or Setting, and the Meridian, can't be answered without resolving an Oblique angled Spherical Triangle, by two or more Proportions; except where there is no Declination, or the Sun or Star be due East or West.*

XIX. QUESTION. *To find the Latitude of the Place* N. *from the Declination of the Sun* 20° 30′ N. *Altitude of the Sun* 47° 30′, *and Time of the Day* 9^h 30^m 32^s *in the Morning being given?*

12^h 0^m 0^s
9 30 32

Time fr. Noon 2 29 28=37° 22′ 5″ Angular Dist. fr. Merid.

First to find the Azimuth.

Say, As Sine Zen. Dist. ☉	42°	30′	0″ co.	0.1703167
To Sun's Dist. fr. Merid.	37	22	5	9.7831396
So Sine ☉ Distance from Pole	69	30	0	9.9715876
To Sine Azimuth from South	57	17	48	9.9250439
	180	0	0	
Azimuth from N. required	122	42	12	

Proceed now as in the XIVth *Question to which this* XIXth *Question is reduced.*

Aſtronomical QUESTIONS (applied to NAVIGATION) anſwered by *Spherical* PROPORTION and LOGARITHMS.

But, a ſmall Error in the Time of Obſervation will make a large one in the Azimuth, and alſo in the Réſult of the Computation, or Latitude.

And ſince an *Azimuth* by Obſervation can ſcarcely ever be truſted to, for finding the Latitude, except it is derived from the obſerved Altitude of the *Sun* or *Star*, the *Method* of determining the Latitude from taking an Altitude, or repeated Altitudes, is always the *beſt*; as being the moſt *accurate*. And the Method by *Meridian Altitudes* of the *Sun* or a *Star* is not only the *moſt eaſy* for determining the Latitudes, but always the *moſt certain*, and *expeditious*.

XX. QUESTION. *To find the Time when the* SUN *will be due* Eaſt *or* Weſt, *from the* Sun's *Declination* 23° 28′ 30″ N. *and Latitude* 51° 28′ 30″, *being given?*

PROPORTION.

		Logarithms.
As Radius	90° 0′	10.0000000
To Cotan. Lat.	51 28 30	9.9009941
So Tang. Sun's Declination	23 28 30	9.6377835
To Sine Sun's Diſt. from 6h	20° 13′ 42″	9.5387776
In Time	± 1h 20m 55s	
Sun due Eaſt	7 20 55 Morn. } reqd.	
Sun due Weſt	4 39 5 After. } reqd.	

N. B. In the Summer the Sun is over the Eaſt and Weſt Points at the above Times, and Declination North. But under them in the Winter at the ſame Declination South.

XXI. QUESTION. *To find the Altitude of the* Sun, *when due* Eaſt *and* Weſt, *the* Sun's *Declination*, 23° 28′ 30″, *and Latitude* 51° 28′ 30″ *being given?*

PROPORTION.

As Sine Latitude	51° 28′ 30″ co.	0.1066064
To Radius	90 0 0	10.0000000
So Sine Declinat. N.	23 28 30	9.6002636
To Sine Sun's Altitude	30 36 33	9.7068700

in Summer or N. Latitude; but Depreſſion in Winter or S. Latitude.

XXII. QUESTION. *To find the Sun's Altitude at Six, from the Declination* 23° 28′ 30″ N. *and Latitude* 51° 28′ 30″ N. *being given?*

PROPORTION.

As Radius	90° 0′ 0″	10.0000000
To Sine Sun's Declination	23 28 30	9.6002636
So Sine Latitude	51 28 30	9.8933936
To Sine Altitude at 6, *required*	18 9 30	9.4936572

XXIII. QUESTION. *To find the Sun's Azimuth at 6, from the Sun's Declination* 23° 28′ 30″ N. *and Latitude* 51° 28′ 30″ N. *being given?*

PROPORTION.

As Radius	90°	10.0000000
To Tan. Sun's Decl. N.	23 28 30	9.6377835
So Coſ. of Latitude	51 28 30	9.7943877
To Cot. Azim. fr. the N. or S. }	74° 51′ 49″	9.4321712 or Tang. fr. E. or Weſt.

N. B. When the Sun's Declination and Latitude are both North, the Azimuth found by the foregoing Proportions, is from the North; when the Declination is South, and Latitude North, the Azimuth is from the South. — The contrary for the Southern Latitude.

☞ *There are many more Queſtions concerning the* Altitude, Latitude, Declination, Azimuth, Amplitude, &c. *of the Sun when in the* Equinoctial, *which are ſolved by one Proportion of* Spherical *Trigonometry*: *which, as they are of a ſingular Nature, and leſs uſeful in Practice than thoſe we have inſerted, we have omitted, to furniſh Amuſement, or Exerciſe, for the young Aſtronomer's Invention. Who being ſuppoſed already acquainted with the Rules and Demonſtration of Spherical Proportion, and with the Idea of ſpherical Lines and Angles, as applied to Aſtronomy and Navigation, we have ſuch Queſtions and their Anſwers to his Inveſtigation: Having inſerted the general Proportion of Spherical Lines and Angles, in a Table of Spherical Trigonometry (as is cuſtomary in moſt Books of the Subject here treated on)* for his ready Uſe and Reference to, further on. As likewiſe the moſt noted or famous *Theorems, Rules*, and *Proportions* in Practice, added, for ſolving all the *Caſes* in *Spherical* and *plain Trigonometry*; without which, not only *Aſtronomy*, but *Navigation*, and all the *Arts* depending upon *theſe Rules*, would be imperfect.

For Demonſtration of which infallible Rules, *we refer the Reader to Mr.* Emerſon's *moſt excellent Treatiſe of* Trigonometry, (as clear and demonſtrative as the *Elements* of *Euclid*) *for ample Satiſfaction. Sold by Mr.* Richardſon, *in* Pater-Noſter-Row.

Of the NATURE and CAUSE of TWILIGHT.

WHEN *Twilight* begins and ends, the Sun is always reckoned about 18° below the *Horizon*: but exactly begins and ends when the Sun-beams paſſing *(as a Tangent, allowing for Refraction)* by the Earth's Surface, through the ſurrounding Body of the Air, or Atmoſphere, to the outer or extreme Parts thereof, from whence (at the Middle of the extreme Atmoſphere, or Meeting of the two Tangents of *Incidence* and *Reflection*) the Illumination or Illuſtration there, of the Sun's first or laſt Rays are reflected, *horizontally*, to the Eye of an *Obſerver*.

As ſoon as which *incident* Rays fall ſhort of meeting the *horizontal* Tangent, at the extreme Parts of the ſurrounding Atmoſphere, in the Evening Twilight ceaſes, and total Night or Obſcurity enſues. And, in the Morning, as ſoon as the Sun's incident Rays meet the *horizontal* Tangent at the outer Parts of the Earth's Atmoſphere, then Twilight begins, and encreaſes its Light till open Day appears by the *general* Illumination of the whole Atmoſphere, every Way reflecting Light; beſides what Light is reflected by the Earth's Surface, and all terreſtrial Objects, which the Sun's Light directly falls upon.

The *Atmoſphere*, varying in its Height and Magnitude, (in the Summer expanding by Heat, *higher*, and condenſing in Winter by Cold, *lower*) is *one Cauſe* of the Variation of the Beginning and End of Twilights, at the ſame certain Times of the Year. Another *Cauſe* is the *variable* Quantity of Matter in the Atmoſphere fit for reflecting Light, not too rare, or too denſe, in this tranſparent Body. Add to which a third *Cauſe* of the Variation of Length, as well as of the Clearneſs of Twilight, which is the Variation of the Sun's etherial Atmoſphere ſurrounding his Body, ſhining before the Sun himſelf riſes, and after he ſets, with variable Luſtre, augmenting the Clearneſs of Twilight, more or leſs, and for a longer or ſhorter Time. The Duration of Twilight is likewiſe reckoned ſomewhat ſhorter in Mornings than on the Evenings of the ſame Days, eſpecially in Increaſe of Twilight; the Morning Twilight is reckoned to begin when Stars of the 5th Magnitude diſappear by its ſuperior Luſtre; and the Evening Twilight ends when the ſame Stars begin to appear, which the Light of the Air before rendered inviſible: As the brighteſt Stars in the whole Heavens vaniſh out of Sight in the Preſence of the ſuperior Luſtre of the Sun.

From theſe *Conſiderations*, it will be eaſy to determine the *Beginning* and *End* of *Twilight*, in all Places, and at all Times of the Year; and alſo the Day of the *ſhorteſt Twilight*. The Height of the Atmoſphere may be meaſured from the known Depreſſion of the Sun, when Twilight begins and ends. All which are ſhewn hereafter.

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* PROPORTION and LOGARITHMS.

XXIV. QUESTION. *To find the Time of Day-Break, in the Morning, and End of Twilight in the Evening, from the Sun's Declination* 10° N. *and Latitude of the Place* 51° 32′ N. *being given?*

RULE.

	° ′		*Logarithms.*
Sun's Zen. Dist. at Beg. and End of Twil.	108 0	Side opp. ∠ reqd.	
Comp. Lat.	38 28	Sides incl. Lo.S.co.	0.2061683
Sun fr. Pole	80 0	∠ reqd. Lo.S.co.	0.0066485
Sum	226 28		
From . . . Half	113 14		
Take Com. Lat. . . 1 *rem.*	74 46	Log. Sine	9.9844660
Take Sun fr. Pole. 2 *rem.*	33 14	Log. Sine	9.7388201
		Sum	19.9361029
	68° 17′ 29″	L. Sine . . Half	9.9680514
Double	136 34 58	∠ from Noon.	
In Time	9^h 6^m 20^s		
	12		

Day-Break, 2^h 53^m 40^s Morning, *required.*

Add the Increase of Sun's Declination for double the ∠ of Day-break from Noon, *viz.* for 18^h 12^m 40^s, to the former Declination 10° N. and *repeat the Operation*, with the same *Zenith Distance and Complement of Latitude*, and the Result will give the exact Time of Twilight ending in the Evening; which however may be taken 9^h 6^m 20^s that Night, Dist. of Morn. Twilight, from Noon, as nearly.

OPERATION repeated.

Increase of the Sun's Decl. in 18^h 12^m . . . 16′ 6″
(*See p. 194. April*) Incr. in . . . 24 . . . being 21 ∙14
Whence, Sun's Decl. at ending of Twil. . . . 10° 16′ 6″ N. [for that Day.

	° ′ ″		*Logarithms.*
Sun's Zen. Dist. at Beg. and End of Twil.	108 0 0	Side opp. ∠ reqd.	
Comp. Lat.	38 28 0	Sides incl. L.S.co.	0.2061683
Sun fr. the Pole	79 43 54	∠ reqd. L.S.co.	0.0070121
Sum	226 11 54		
From . . Half	113 5 57		
Take Comp. Lat. 1. *rem.*	74 37 57	Log. Sine.	9.9841878
Take Sun fr. Pole. 2. *rem.*	33 22 3	Log. Sine.	9.7403683
		Sum	19.9377365
	68° 33′ 50″	Log. S. . . Half	9.9688682
Double	137 7 40	∠ from Noon.	

In Time fr. Noon 9^h 8^m 31^s at Night, Twil. ends, reqd.
In T. fr. Noon, 9 6 20 Twil. begun.

Dif. 2 11 Twilight longer in the Evening [than in the Morning.

The same Method finds the Beginning and Ending of Twilight for South Declination of the Sun, in any Latitude, the Sun's Zenith Distance, at that Time, being always 108°.

N. B. The Twilight *increases* from *March* 2, to its greatest; and then *decreases* to *October* 11, at *London*, again at its shortest. Then it increases to Sun in ♑, then decreases to *March* 2, then increases as before, *&c.*

When the Sun descends just 18° below the Horizon, at Midnight, then there is no Darkness or Night, but all Twilight begins to take Place. This happens when the Sun's Declination is equal to the Difference between the Complement of Latitude of the Place of the same Name with the Sun's Declination, and 18° the Depression at Midnight. In the Latitude of 51° 32′ N. the Complement of Latitude is 38° 28′, from which deducting 18°, the Depression, there remains 20° 28′ N. Declination of the Sun, when Darkness disappears, in that Latitude, which is from the 22d of *May* to the 21st of *July* (see P. 195.) N. S. when Night again returns.

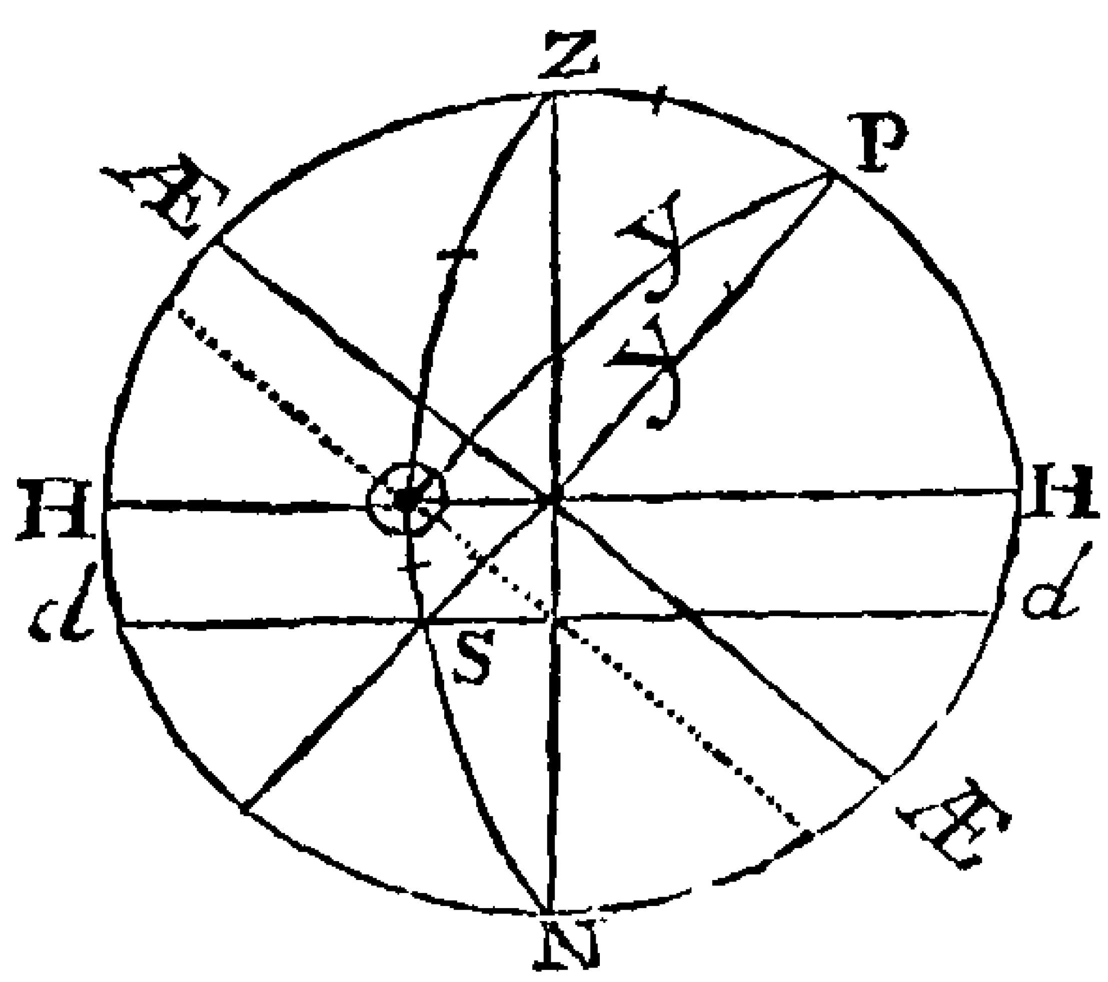
But from the Sun's Excursion from, to his Return to, this *Limit*, in the Latitude, *London*, it is all Twilight, from Sun-Setting to Sun-Rising; being the *longest* Duration of Twilight that can happen there.

As this *longest* Twilight happens when the Sun's Point or Place of Declination (*of the same Name with the Latitude*) descends the most obliquely or most parallel with the Horizon, to 18° below it, and consequently descends most slowly; so the *shortest Twilight* always happens, when the Point of the Sun's Declination (*of contrary Name to the Latitude*) descends in the most *perpendicular* Direction to the Horizon; or descends fastest to 18° Depression in any Latitude: Supposing the Sun's Declination to be invariable, or *nearly* so, for the Time betwixt Rising and Setting, and 18° Depression, below the Horizon.

Hence, when the *Sun* has the same *Azimuth* at 18° Depression below the Horizon, that he had at Setting, his Descent will be *perpendicular* to the Horizon, and therefore on that Day, and Declination (*of contrary Name to that of the elevated Pole*) the Twilight will be the *shortest possible*, in any given Latitude. This Consideration furnishes a *New Method* of finding the Time of *shortest Twilight*, as follows.

XXV. QUESTION. *To find the Day of the* shortest *Twilight, from the Latitude* 51° 32′ *being given?*

☞ *The Time of the shortest Twilight, is when the Sun's Azimuth, during that Time, increases or decreases the least or slowest,* viz. *not at all.*



In the *Figure*,

Put m and n = Sine and Cos. of ZS = 108°.
p and q = Sine and Cos. ZP = Comp. Lat.
1 = Rad. = ☉Z,
And y = Cosine ☉P = SP, Dist. fr. Pole.

Aſtronomical QUESTIONS (in PRACTICE) anſwered by *Spherical* Proportion *and* Logarithms.

Then (by a known Theorem*) $\frac{y}{p}$ = Coſ. ∠ ☉ZP. And $\frac{nq-y}{mp}$ = Coſ. ∠ SZP. Which *Angles* being equal, their *Coſines* are alſo equal, or $\frac{y}{p} = \frac{nq-y}{mp}$, whence, $y = \frac{nq}{m+1}$, a general Theorem, *for anſwering all Queſtions of this Nature.*

Hence, $m+1 : n :: q : y$, the Sine of the Sun's *Declination, of contrary Name to the Latitude,* required.

Or, in Words at Length, *Com.* Nrs.

As the Sine of 72° and Radius *added*, *viz.* 1,9510565
Is to the Sine of 18°, ,3090170
So is the Sine of the Latitude,
To the Sine of the Sun's Declination,
On the Day of the *ſhorteſt Twilight.*

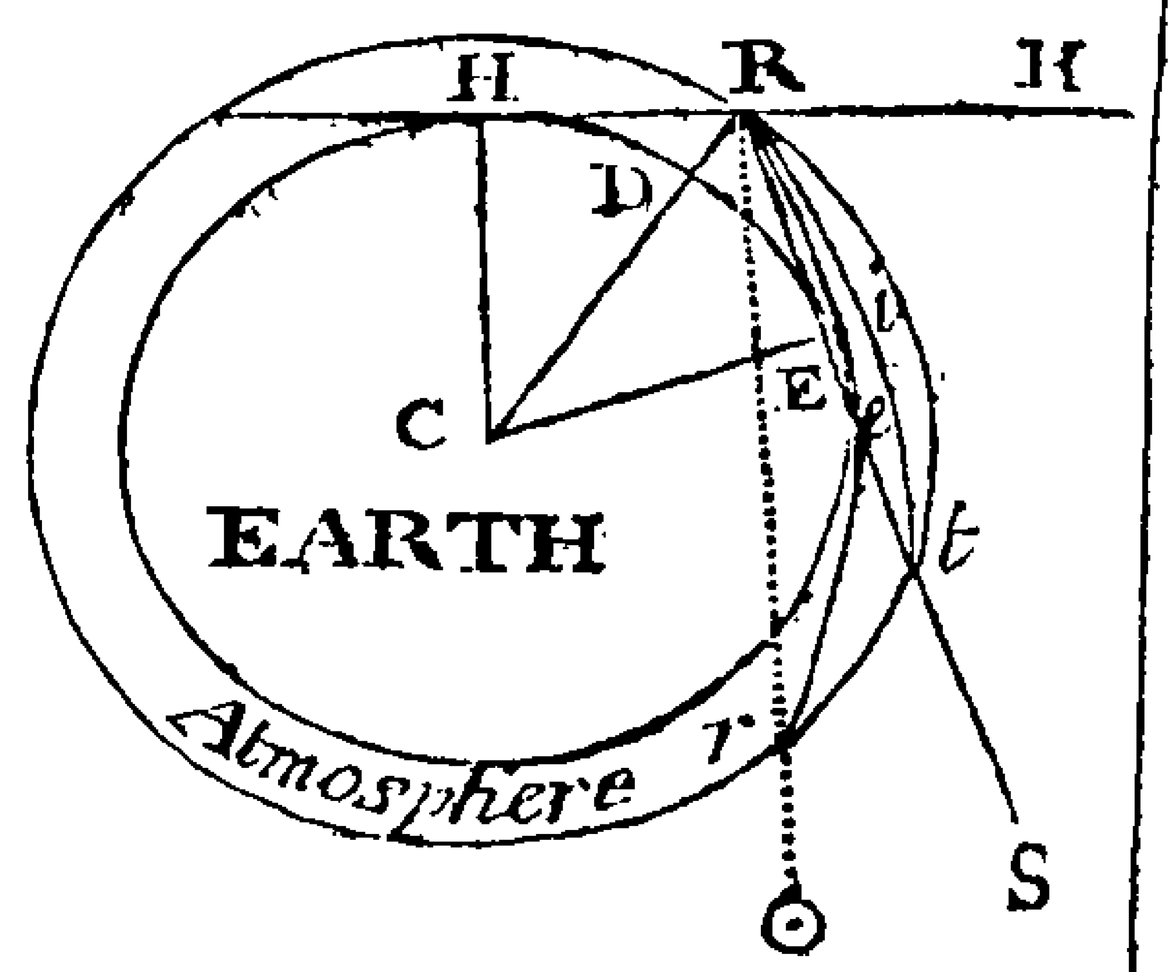
		Logarithms.
Or, to the *conſtant* Logarithm . . .		9.1997126
Add the Log. Sine of the Latitude	51° 32′	9.8937452
Sine Sun's Declin. S. reqd. 7° 7′ 25″ . . Anſwering to *March* 2d and *Oct.* 11.		9.0934578

Otherwise, according to the *common Method.*

As Radius	90° 0′	10.0000000
To Tang. ½ Depreſſion	9 0	9.1997125
So Sine Latitude	51 32	9.8937452
To Sine Sun's Declin. reqd. . . 7° 7′ 25″ S.		9.0934577

anſwering to *March* 2, and *Oct.* 11, as before; between which Times the *Twilights* increaſe; and from the latter to the former of which Times, they *decreaſe*. The *Days* (different to the Increaſe and Decreaſe of *Twilights*) increaſe from the Sun in ♑ to his Arrival in ♋, and decreaſe from ♋ to ♑, in all Latitudes.—While the Days increaſe the Afternoon Half-Days are the longer; but while the Days decreaſe the Forenoon Half-Days are longer than thoſe of the Afternoon. Which Conſideration furniſhes a *Rule* (by Proportion) for determining the Difference of Time, between Forenoon and Afternoon Obſervations, from Noon, in the *Method of correſponding or ſame Altitudes of the Sun*; by having the Diſtance, *in Time*, of the two Obſervations of the ſame Altitudes of the Sun, (in the Forenoon and Afternoon) given.

XXVI. Question. *To find the Height of the Earth's Atmoſphere, or of its ſurrounding Body of Air, from the Sun's Depreſſion* 18°, *at the Beginning and End of Twilight, being given?*



THE Time of the Beginning or End of Twilight being given, the Sun's *Depreſſion* at that Time, is found nearly as above, *viz.* 18°, by *ſpherical Trigonometry*.

At which Time, the Sun's *laſt Ray* S R, touches the Earth's Surface at E, and is reflected by a Particle of Air from the Top of the Atmoſphere, at R, to the *Obſerver*'s Eye at H, in a horizontal Direction RH. And ſince HH repreſents the Horizon, the ∠ HRS, = the Sun's Depreſſion, = 18°.

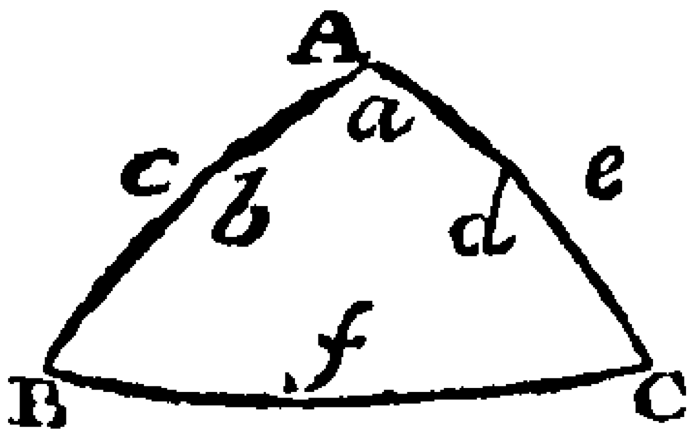
Now, *becauſe* SR and HR, are both *Tangents* to the Earth's Surface, at H and E, meeting at the Top of the Atmoſphere, R, the Angle HCE, at the Earth's Center, is equal to the Angle SRH = 18°; whoſe Half, or the Angle HCR is equal to Half ∠ SRH, = 9°; which would be correctly ſo, if the Ray SR paſſed ſtrait through the Atmoſphere without Refraction. But becauſe the Sun's Rays are refracted and bent towards CR, (all the Way of their Paſſage, by the Earth's Surface, from one Part of the external Atmoſphere to their Arrival at the Top of the contrary Part thereof) therefore the Angle of Depreſſion will be ☉RH = 18°, and the ∠ ☉RS will be the Sun's horizontal Refraction = 30′, at leaſt; whence, the ∠ SRH = 17° 30′: the Sun's Rays paſſing directly in the ſtrait Line ☉r, till they meet the outſide of the Atmoſphere in *r*, and then paſs thro' it in the curved Line *reR* to R, the oppoſite Part thereof, from whence they are horizontally reflected to the *Obſerver* at H.

NOW, ½ ∠ SRH = ∠ RHC = ∠ RCE = 8° 45′
The Comp. = ∠ CRH = 81 15

			Logarithms.
Say,	As ∠ CRH . . . . 81° 15′ . . co.		0.0050842
	To CH, Earth's Rad. 4000 Miles . . .		3.6020600
	So Radius	S. 90°	10.0000000
	To CR = 4047 Miles.		3.6071442
	— 4000 = CD.		

Miles 47 = DR, the Height of the Atmoſphere, *required.*

* *The* Rectangle *of the* Coſines *of two Sides, including an Angle of any Spherical Triangle,* plus *or* minus, *the Product of the* Sines *of thoſe including Sides, and the Coſine of the included Angle* (plus *when the included Angle is leſs, and* minus *when it is more, than a right Angle) is equal to the* Coſine *of the Side oppoſite to the included Angle.*



Hence in the *Spherical* Triangle, ABC, when the inſide Letters denote the *Coſines*, and outſide Letters denote the *Sines*, of the given Sides and Angle, included.

Then $bd \pm cae = f$. Hence a (when ∠ A leſs than 90°) $= \frac{f-bd}{ce}$, or (when Angle A is greater than 90°) $= \frac{bd-f}{ce}$.

$b = \frac{f-cae}{d}$, or $d = \frac{f-cae}{b}$ (when ∠ A leſs than 90°.) But $b = \frac{f+cae}{d}$, and $d = \frac{f+cae}{b}$, when ∠ A is greater than 90°)

But

Aſtronomical QUESTIONS (in PRACTICE) anſwered by *Spherical* PROPORTION and LOGARITHMS.

But ſuppoſing the Sun's *Rays*, in entering the Atmoſphere, at 18° Depreſſion, deſcribe S*ti*R, or *nearly* ſo.

Then the ∠ SRH = 18°, and ∠ RCH = 90°
[and ∠ CRH = 81°

Wherefore,

		Logarithms.
Say, As ∠ CRH	81° co.	0.0053801
To CH, Earth's Rad. 4000 Miles . .		3.6020600
So Radius	S. 90°	10.0000000
To CR = 4050 Miles, ferè.		3.6074401
— 4000 = C D.		

Miles . . 50 = DR, the Height of the Atmoſphere, (*at moſt*) required.

XXVII. QUESTION. *To find the Declination of the Moon, of a Planet, or Star, from the Longitude* (ſuppoſe of the Moon) 1762, Paris, April 1, *at Noon*, ♋ 5° 27′, *and Latitude* 4° 11′ N. *being given?*

PROPORTION.

As Radius . . . . S.	90°			10.0000000
To S. Long. from the neareſt equinoct. Point ♈ or ♎	84°	33′		9.9980323
So Tan. Ecl. Obliquity	23°	28′	30″	9.6377835
To Tan. 4th Arc	23	22	49	9.6358158
From	85	49	0	Comp. ☽ Lat.
5th Arc . . Rem.	62	26	11	

☞ *If the given Latitude and Sign of the Longitude, be of the ſame Name, the 4th Arc ſubtracts from the Complement of the given Latitude for a 5th Arc; if the Latitude given and Sign of the Longitude be of a different Name, then the 4th Arc adds to the Complement of given Latitude for a 5th Arc.*

NOW, As Coſ. 4th Arc . . .	23°	22′	49″ co.	0.0372088
To Coſ. 5th Arc . . .	62	26	11	9.6653306
So Coſ. Ecl. Obliq. : .	23	28	30	9.9624801
To S. Decl. N. req^d.	27	32	32	9.6650195

EXAMPLE II. 1760, Paris, Auguſt 5, Moon's *Longitude at Noon*, ♉ 29° 52′, *Latitude* S. 1° 28′, *required the Declination* N.

According to the ABOVE-RULE.

As Radius . . . . S.	90°			10.0000000
To S. Long. fr. next equin. Point ♈	59°	52′		9.9369456
So Tan. Eclip. Obliquity . . .	23°	28′	30″	9.6377835
To Tan. 4th Arc	20	35	11	9.5747291
Lat. and Decl. Dif. Name . . Add	88	32	0	Comp. ☽'s Lat.
5th Arc . . . Sum	109	7	11	
	180			
To Coſ. 5th Arc	70	52	49	9.5152685
As Coſ. 4th Arc	20	35	11 co.	0.0286578
So Coſ. Ecl. Obliquity	23	28	30	9.9624801
To S. Declination N. required. . .	18	43	8	9.5064064

Being a Proof of the Truth of M. *De la Caille*'s *Ephemerides*.

N. B. The two Examples above contain all the Caſes that can happen, in finding the Declination of the *Moon*, a *Planet*, or the *Stars*, from their Longitudes and Latitudes, reſpectively, given.

XXVIII. QUESTION. *To find the Right Aſcenſion of the Moon, and of any Star, or Planet, from the Longitude, Latitude, and Declination thereof, being given?*

Required the Right Aſcenſion of the Moon, in the foregoing Inſtances, Longitude ♋ 5° 27′ 0″, Latitude 4 11 0 N., Declination 27 32 34 N. } given.

PROPORTION.

				Logarithms.
As Coſ. Declination	27°	32′	32″ co.	0.0522378
To Coſ. Long. fr. next eq. Point ♎	84	33	0	8.9776188
So Coſ. Latitude	4	11	0	9.9988414
To Coſ. R. Aſcenſion, fr. ♎, req^d.	83	52	2	9.0286980
	180	0	0	
Or R. A. fr. ♈ . .	96	7	58	

EXAMPLE II. Longitude ☽ . . ♉ 29° 52′ 0″, Latitude . . . . 1 28 0 S., Declination . . . 18 43 8 N. } given.

As Coſ. Declination	18°	43′	8″ co.	0.0236021
To Coſ. Long. fr. next eq. Point ♈ . .	59	52	0	9.7007158
So Coſ. Latitude	1	28	0	9.9998577
To Coſ. R. A. fr. next eq. Point ♈, required	58	0	10	9.7241756

So for the Reſt.

☞ The above Queſtion may be otherwiſe anſwered by finding an Angle APE of a *Spherical* Triangle, whoſe Sides,
AP the Comp. Declination,
AE the Comp. Latitude,
PE conſtant Diſt. of the two Poles of Ecliptic and Equinoctial 23° 28′ 30″ } are given.
The Sides including the required ∠ being AP, PE.

XXIX. QUESTION. *To find the Right Aſcenſion of a Star, or Planet, from the Longitude and Latitude thereof being given?*

Here, In △ APE, are given ∠ E, Sides AE and PE, to find ∠ P?

Longitude of the Moon . . ♋ 5° 27′ 0″, Latitude . . . . 4 11 0 N. } given.
To find the Right Aſcenſion of the Moon in that *Poſition*.

PROPORTION.

As Radius . . . . S.	90°			10.0000000
To S. Long. fr. next eq. Point ♎ . .	84°	33′	0″	9.9980802
So Cotan. Latitude N.	4	11	0	11.1358275
To Tan. 4th Arc	85	47	54	11.1339077
Ecliptic Obliquity —	23	28	30	Sig. Long. and Lat. of like Name.
The 5th Arc . . Dif.	62	19	24	

☞ *When the given Latitude and Sign of the Longitude are of the ſame Name* N. *or* S. *you muſt ſubtract the Ecliptic Obliquity from the 4th for a 5th Arc. But if the Latitude and Sign of the Longitude are of a different Denomination, you muſt add the Ecliptic Obliquity, to the 4th for a 5th Arc.*

{ ♈, ♉, ♊, ♋, ♌, ♍, Northern Signs.
{ ♎, ♏, ♐, ♑, ♒, ♓, Southern Signs.

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* PROPORTION and LOGARITHMS.

				Logarithms.
Now, As Sine 4th Arc	85°	47′	54″ co.	0.0011696
To Sine 5th Arc	62	19	24	9.9472292
So Tan. Lon. fr. next Eq. Point ♈ fr. ♎	84	33	0	11.0204135
To Tan. R. A. fr. ♎ required .	83	52	2	10.9688125
	180	0	0	
Or Right Ascension from ♈ . . .	96	7	58	

EXAMPLE. II. Longitude ☽ ♉ . . 29° 52′ ; Latitude . . . . . 1 28 S. } given.

To find the Right Ascension ☽ *in that Position?*

By the *above Rule*.

As Radius Sine	90°	0′	0″	10.0000000
To Sine Long. from next Eq. Point ♈	59	52	0	9.9369456
So Cotan. Latitude South	1	28	0	11.5916963
To Tan, 4th. Arc	88	18	15	11.5286419
Ecliptic Obliquity . . . . . . +	23	28	30	Sig. Long. and Lat. of dif. Name.
The 5th Arc . . . . . Sum	111	46	45	
	180	0	0	
Now, To Sine 5th Arc . . .	68	13	15	9.9678384
As Sine 4th Arc	88	18	15 co.	0.0001903
So Tan. Longitude from ♈ . . .	59	52	0	10.2362298
To Tan. R. A. from ♈ required .	58	0	10	10.2042585

Star or	♋, ♌, ♍, ♎, ♏, ♐,	Lat. S.	R.A.	Lat.N.	R. A.
Planet in	♑, ♒, ♓, ♈, ♉, ♊,	Lat.N.	less.	Lat. S.	greater

than Sun R. A. in the Ecliptic, being in the same Signs.

XXX. QUESTION. *To find the Longitude and Latitude of a Star or Planet, from the Right Ascension and Declination thereof, being given?*

☽'s Right Ascension from ♈ 99° 7′ 58″ ; Declination North . . . 27 32 32 } given.

To find her Latitude North and Longitude from Aries.

PROPORTION.

As Radius Sine	90°	0′	0″	10.0000000
To Tangent Ecliptic Obliquity .	23	28	30	9.6377835
So Sine R.A. from next Eq. Point ♎	83	52	2	9.9975074
To Tangent 4th Arc	23	21	18	9.6352909
+	62	27	28	comp. given Decl. N.
Fifth Arc . . . . Sum	85	48	46	
Now, As Cosine 4th Arc . . .	23	21	18 co.	0.0371260
To Cosine 5th Arc	85	48	46	8.8634167
So Cosine Ecliptic Obliquity . . .	23	28	30	9.9624801
To Sine Latitude N. required . .	4	11 N.		8.8630228

N. B. *When the Right Ascension and Declination given are of the same Name, N. or S. the Complement of the Declination given* adds *to the 4th for the 5th Arc: But when the Right Ascension and Declination given are of different Name, the 4th Arc* subtracts *from the Complement of Declination for the 5th Arc.*

Now, to find the Longitude from Libra.

PROPORTION.

As Cosine Latitude N.	4°	11′	0″ co.	0.0011586
To Cosine R.A. from next Eq. Point ♎	83	52	2	9.0287050
So Cosine Declination	27	32	32	9.9477622
To Cosine Lon. from next Eq. Point ♎	84	33	0	8.9776258
	180	0	0	
Longitude from ♈	95	27	0 or ♋ 5° 27′ reqd.	

Being the Converse to the Proportions answering to the XXVIII. Question.

EXAMPLE II. ☽'s R. Ascension from ♈ 58° 0′ 10″ ; Declination . . . . 18 43 8 N. } given.

To find her Latitude South and Longitude from ♈.

PROPORTION as before.

				Logarithms.
As Radius Sine	90°	0′	0″	10.0000000
To Tan. Ecliptic Obliquity . . .	23	28	30	9.6377835
So Sine R. A. from ♈	58	0	10	9.9284336
To Tangent 4th Arc	20	13	10	9.5662171
+	71	16	52	Comp. Decl. ☽ N.
Fifth Arc.	91	30	2	
As Cosine 4th Arc	20	13	10 co.	0.0276232
To Cosine 5th Arc	91	30	2	8.4180797
So Cosine Ecliptic Obliquity . .	23	28	30	9.9624801
To Sine Latitude S. required . .	1	28	0	8.4081830

NOW, *To find the Longitude from* Aries.

As Cosine Latitude S.	1°	28′	0″ co.	0.0001423
To Cos. R.A. fr. the next Eq. Point ♈	58	0	10	9.7241760
So Cosine Declination N.	18	43	8	9.9763979
So Cos. Long. fr. same Eq. Point ♈	59	52	0	9.7007162
or, ♉	29	52	0 required.	

☞ *In the Triangle* APE *of the foregoing Question, are given the constant Distance of the Poles of the Equator* PE, *and Ecliptic* 23° 28′ 30″, *the Complement of Declination (or* 90° *and contrary Declination)* AP, *with the included* ∠ *of Right Ascension from the Solstitial Colure of* ♋ *or* ♑, P, *to find the Side opposite to that* ∠, *viz.* AE, *whose Complement to* 90° *is the Latitude; or Excess above* 90°, *the contrary Latitude, required.*

And also to find the ∠ E. *at the Pole of the Ecliptic, included between the said opposite Side* AE, *last found, (on which the Latitude is measured) and the constant Distance of the Poles (aforesaid)* PE; *which* ∠ E *found, will be the Longitude required from the same Solstitial Colure of* ♋ *or* ♑.

NOW, *The Right Ascension at* P, *and Longitude at* E, *from* ♋ *or* ♑ *being known, the Right Ascension and Longitude from* ♈ *and* ♎, *will be also known; the latter being the Complements of the* former *to* 90°

XXX. QUESTION. *To find the Longitude of a Star, Planet, or Comet, from the Latitude* 2° 59′ N. *and Declination* 20° 1′ S. *being given?*

N. B. This Question is resolved by a Projection on the *Solstitial Colure*. In a Spherical Triangle APE (AP being ✳'s Dist. from the N. Pole of the World, AE ✳'s Dist. from the N. Pole of the Ecliptic, PE Distance of the two Poles, and ∠ E the Longitude from ♋, and ∠ P, the Right Ascension from ♑)

						Logarithms.
*AP=✳'s D. fr. N. Pole World .	110°	1′	0″	Sides op. ∠ reqd.		
AE=✳'s Dist. fr. N. Pole Ecliptic .	87	1	0	Sides inclu. ∠ required.	L.S.co.	0.0005890
PE=Dist. of the two Poles . . .	23	28	30		L.S.co.	0.3997364
Sum	220	30	30			
From . . . Half	110	15	15			
Take AE, 1 Rem.	23	14	15	L. S.		9.5960948
Take PE, 2 Rem.	86	45	45	L. S.		9.9993134
					Sum	19.9957336
	84	19	33 ½	L. S.	Half	9.9978668
Double is ∠ E	168	39	7	Longitude from ♋ following.		
Subtract 5 Signs	150	0	0	♋, ♌, ♍, ♎, ♏.		
Place of the Star, Planet or Comet. ♐	18	39	7	In 2d. Quadrant of the Ecliptic.		
Or,	168	39	7	Longitude from ♋ preceding.		
♑	180	0	0			
Viz. ♑	11	20	53	in 4th Quadrant of the Ecliptic.		

* Are given to find ∠ E fr. ♋.

Each

Aſtronomical QUESTIONS (in PRACTICE) anſwered by *Spherical* Proportion and Logarithms.

Each Place being 78° 39′ 7″ from the neareſt Equinoctial Point ♎ and ♈ reſpectively.

N. B. *The Place (of the two here found) muſt be determined by the near Situation of the* Planet *or* Comet *whoſe Longitude is required, in reſpect of ſome known* Star, *whoſe Longitude is given.*

Example II. *To find the Longitude of the* Pleiades *in the* 294*th Year before* Chriſt, *from their Declination at that Time* 14° 30′ N. *and Latitude* 4° N. *being given.?* See fol. 12, Sherbone; fol. 56, Vincent Wing, Inſt. and Page 16, Street.

In a *Spherical* △ APE, as before,

Are given* to find ∠ E fr. ♋	*AP= 75°	30′	0″	Side op. ∠ required.		*Logarithms.*
	AE= 86	0	0	Sides inclu.	L.S.co.	0.0010592
	PE= 23	28	30	∠ required	L.S.co.	0.3997364
Sum	184	58	30			
From Half	92	29	15			
Take AE. 1 Rem.	6	29	15	L. S.		9.0530263
Take PE. 2 Rem.	69	0	45	L. S.		9.9701881
					Sum	19.4240100
	31°	0′	47″	L. S.	Half	9.7120050
Double is ∠ E	62	1	34	Longitude, from ♋ preceding.		
	90	0	0	♋ from ♈		
Place of *Pleiades* 294 Y. bef. Chr.	♈ 27	58	26	required.		
Pl. 1720 ſince Xt.	♉ 26	5	8	*Halley.*		
Sum 2014 Yrs.	28	6	42	Increaſe of Place.		

2014)101202″(50″ 14‴ 57iv. $\frac{321}{1007}$

Annual Motion of the Stars in following Order.

XXXI. Question. *To find the Right Aſcenſion of a Star, Planet, or Comet, from the Latitude* 2° 59′ N. *and Declination* 20° 1′ S. *being given, in the former or* 30*th Queſtion?*

In a *Spherical* Triangle APE,

Are given* to find ∠ P from ♑	*AE= 87°	1′	0″	Side op. ∠ required.		
	AP= 110	1	0	Sides inclu.	L.S.co.	0.0270602
	PE= 23	28	30	∠ required	L.S.co.	0.3997364
Sum	220	30	30			
From Half	110	15	15			
Take AP, 1 Rem.	0	14	15	L. S.		7.6175397
Take PE, 2 Rem.	86	46	45	L. S.		9.9993134
					Sum	18.0436497
	6°	2′	10″	L. S.	Half	9.0218248
Double is ∠ P,	12	4	20	R. A. from ♑ preceding.		
	180	0	0			
	167	55	40	R.A. ✱ &c. from ♋ following.		
	90	0	0	R. A. ♋ from ♈		
Sum	257	55	40	R. A. from ♈.		
Or,	120	4′	20″	R. A. ✱, &c. from ♑ following.		
	270	0	0	R. A. of ♑ from ♈.		
Sum	282	4	20	R. A. from ♈ following.		

N. B. *The Right Aſcenſion of the two here found, muſt be determined by Circumſtances, or* Phenomena *accompanying the above* Data; *the Vicinity of a Comet or Planet to a known Star of given Right Aſcenſion, &c.* But here in the ſame Caſe, when the Longitude is from ♈ or ♎, the Right Aſcenſion is from the ſame Equinoctial Point.

Example II. *To find the Right Aſcenſion of the* Pleiades *in the* 294*th Year before* Chriſt, *from their Declination at that Time* 14° 30′ N. *and Latitude* 4° N. *being given, as in the former Queſtion?*

In a *Spherical* Triangle APE,

Are given* to find ∠ P fr. ♑, or its Supt.	*AE=86°	0′	0″	Side op. ∠ required.		*Logarithms.*
	AP=75	30	0	Sides inclu.	L.S.co.	0.0140584
	PE=23	28	30	∠ required	L.S.co.	0.3997364
Sum	184	58	30			
From Half	92	29	15			
Take AP. 1 Rem.	16	59	15	L. S.		9.4656253
Take PE. 2 Rem.	69	0	45	L. S.		9.9701881
					Sum	19.8496082
	32°	45′	11″	L. S.	Half	9.9248041
Double is the Supplement ∠ P	65	30	22	R. A. *Pleiades* from ♋ preceding.		
R. A.	90	0	0	♋ from ♈.		
R.A. *Pleiades* in the 294th Y. bef. Xt.	24	29	38	from ♈ following required.		

☞ *The Supplement of the included ∠ is, in the Caſe above, found inſtead of the included ∠ itſelf; the Sine and Sine of its Supplement to* 180° *being the ſame. This Diſtinction muſt be carefully regarded, according to the Nature of the three Sides of the Spherical Triangle given, that it may be known from what Part of the Solſtitial Colure ♋ or ♑, the ∠ of Right Aſcenſion, or Longitude is determined.*

When you would find the Times of *Riſing* and *Setting* of the Moon, or Planets, or the Time, at any Altitude, their Amplitudes of Riſing and Setting, &c. You muſt ſubſtitute the Times of their Paſſage through the ſame *Meridian*, in the preceding Calculations, inſtead of *Noon*, the Time of the Sun's Paſſage.

The Time of a Planet from the Meridian, is reduced to an Arc of the Equator by this Proportion.

As the Interval of the Time betwixt two next Paſſages of the Moon or a Planet, through the ſame Meridian is to 360° *ſo is the Interval betwixt the given Time, and the Time of neareſt Paſſage through the Meridian, to the Degrees, Minutes and Seconds of the Planets angular Diſtance, meaſured on the cœleſtial Equator, from the ſame Meridian, when the Altitude of the Planet is required.*

XXXII. Question. *To find the Altitude of Mars, the* 12*th* Feb. 1758, *at Six in the Morning; being the ſame as the* 11*th* Feb. 18ʰ *paſt Noon?*

		h	m	s	
♂ paſſed the Meridian 1758, Feb.	11	11	16	40	At *Paris De la Caille*'s Ephem.
	12	11	11	20	
	Dif.	0	5	20	
		24	0	0	
Interval of ♂ Return to the ſame Merid.		23	54	40	

	d	h	m	s	
Feb.	11	18	0	0	Time given.
	11	11	16	40	Souths.
♂ from Meridian	0	6	43	20	Paſt.

As 23ʰ 54ᵐ 40ˢ : 360° :: 6ʰ 43ᵐ 20ˢ : 101° 12′ 29″ Correſpondent Diſt. ♂ from Meridian, 1758. Feb. 11ᵈ 18ʰ

Declination ♂ 21° 52′ 0″ N. Feb. 11ᵈ 18ʰ 1758, *La Caille.*
48 50 10 N. Height Pole, *Paris.*

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* Proportion and Logarithms.

By PROPORTION, Quest. XI.

				Logarithms.
As Radius	90°	0′	0″	10.0000000
To Sine Comp. Dist. ♂ fr. Meridian	101	12	29	9.2886448
So Tan. Comp. Lat. *Paris*, . . .	48	50	10	9.9416710
To Tangent Arc X	9	38	43	9.2303158
Dist. ♂ from Pole + ...	68	8	0	See *Below*.*
To Sine Complement Arc Y . .	77	46	43	9.3256996
As Sine Complement Arc X . .	9	38	43 co.	0.0061844
So Sine Latitude	48	50	10	9.8766969
To Sine Altitude ♂ required . .	9	18	10	9.2085809

M. *De la Caille* made it (See his Ephem.) 9 12 8 only.
Who found the Arc X 9° 47′ (*See p. 16 La Caille Eph.*) instead of 9° 38′ 43″ as above.
Who finds 101° 12′ 25″ = 6h 43m 20s
instead of 101 12 29 = as above.

* *When Distance from the Meridian is above* 6h *or* 90° *add* X *to the Planet's Distance from Pole for* Y. *if less, subtract* X *from Pole's Distance from Planet for* Y.

N. B. The *same Method* as that above serves for all other *Planets*, and also the *Moon*; if you observe to take out of an *Ephemeris* the true Interval of Time betwixt the two next Passages of the *Moon*, or a *Planet* through the same Meridian, for proportioning their Distances in Time therefrom, either before or after their Passage at a Time given by the Clock.

XXXIII. Question. *To find the Right Ascension of the Mid-Heaven Ecliptic at the Meridian, from the Sun's Place, or R. Ascension, and the Time of the Day or Night being given?*

Rule. To the Sun's Right Ascension in Degrees, Minutes, &c. found to the Time given, when Right Ascension of Mid-Heaven is required, add the Degrees, &c. of that Time from the former Noon (allowing 15° Degrees to an Hour) and the Sum rejecting 360° if above) will be the R. Ascension of the Mid-Heaven, at the Meridian, required.

Example. Required the Right Ascension of Mid-Heaven for 1764, March 30th, 10h 20m in the Forenoon?

Sun's R. A. in Time.

1764 Mar. 29, Noon 34m 6s } *De la Caille*'s Ephemerides.
30, Noon 37 43 }

Increase Sun's R. A. in 24h 3 37
As 24h : 3m 37s :: 22h 20m : 3m 22s Increase.
+ 34 6

Right Ascension in Time 1764, Mar. 30th, 10h 20m Morn. } 37 28
By Table p. 28. . . . . . . 37m 0s . . 9° 15′ 0″
0 28 . . 0 7 0

R. A. of the Sun in Degrees at the Time 9 22 0
(*Or See p.* 194.)
Now, 22h 20m reduced to Degrees = 335° 0′ 0″

Right Ascension of Mid-Heaven required . . Sum 344 22 0
360 0 0

R. A. of Mid-Heaven, short of ♈ . . . 15 38 0

☞ When the *Sum* aforesaid is less than 90° it is Right Ascension Mid-Heaven from ♈ following; if above 90° and less than 180, subtract it from 180, for R. Ascension of Mid-Heaven from ♎ preceding; if more than 180, and less than 270, subtract 180 from it for R. A. of Mid-Heaven from ♎ following: But if it is above 270°, and less than 360, subtract it from 360° for Right Ascension of Mid-Heaven from ♈ preceding, as in the Example given.

This Question is of singular Use in the Computation of Eclipses, subservient to Navigation.

XXXIV. Question. *To find the Point of the Ecliptic at the Meridian, or Mid-Heaven Longitude, correspondent to the Mid-Heaven Right Ascension* 15° 38′ *from* ♈ *preceding; and Ecliptic obliquely* 25° 28′ 30″ *being given?*

PROPORTION.

				Logarithms.
As Radius	90°	0′	0″	10.0000000
To Cosine Ecliptic Obliquity	23	28	30	9.9624801
So Cot. R. A. Mid-Heaven .	15	38	0	10.5531022
To Cot. Mid-Heaven fr. ♈ preceding	16	57	58	10.5155823
	12s 0	0	0	
Longitude Mid-Heaven rem. Sig. .	11 13	2	2	or culminating [Point of the Ecliptic required.

N. B. The Mid-Heaven Longitude is always found from the same Equinoctial Point ♈ or ♎, that the Mid-Heaven Right Ascension is taken from.

XXXV. Question, *To find the Meridian Angle, or Angle of the Ecliptic and Meridian, from the Mid-Heaven Right Ascension* 15° 38′ *and Ecliptic Obliquity* 23° 28′ 30″ *being given?*

PROPORTION.

As Radius	90°	0′	0″	10.0000000
To Sine Ecliptic Obliquity	23	28	30	9.6002636
So Cosine R. A. Mid-Heaven . . .	15	38	0	9.9836290
To Cosine Meridian ∠ required . . .	67	26	33	9.5838926

XXXVI. Question. *To find the Mid-Heaven Declination, or Declination of the Point of the Ecliptic at the Meridian, from the Mid-Heaven Right Ascension* 15° 38′ *and Ecliptic Obliquity* 23° 28′ 30″, *being given?*

PROPORTION.

As Radius	90°	0′	0″	10.0000000
To Tan. Ecliptic Obliquity	23	28	30	9.6377835
So Sine R. A. Mid-Heaven	15	38	0	9.4305267
To Tan. Declination on the Merid. S. reqd.	6	43	15	9.0683102

N. B. When the Right Ascension of the Mid-Heaven is above 180°, as in the present Case, then the Mid-Heaven Declination of the Ecliptic Point is South. But if the Mid-Heaven Right Ascension is less than 180°, then the Mid-Heaven Longitude being North, the Mid-Heaven Declination will be North.

XXXVII. Question. *To find the Altitude of the Mid-Heaven, from the Latitude of the Place* 51° 28′ 30″, *and Mid Heaven Declination* 6° 43′ 15″ S. *being given?*

Rule: If the Latitude and Mid-Heaven Declination are of the same Name, add the Declination to the Complement of Latitude for the Mid-Heaven Altitude.

If the Latitude and Mid-Heaven Declination are of *different Names*, subtract the Declination from the Complement of Latitude for the Mid-Heaven Altitude.

Example. Complement of Latitude . . . 38° 31′ 30″ N.
Mid-Heaven Declination . . . 6 43 15 S.

Mid-Heaven Altitude required . . 31 48 15

Aſtronomical QUESTIONS (in PRACTICE) anſwered by *Spherical* PROPORTION and LOGARITHMS.

XXXVIII. QUESTION. *To find the Altitude of the Nonageſimal, or 90th Degree of the Ecliptic from the Horizon (being equal to the Angle of the Ecliptic and Horizon) from the Mid Heaven Altitude 31° 48′ 15″, and the Meridian Angle 67° 26′ 33″ being given?*

	°	′	″	*Logarithms.*
As Radius Sine	90	0	0	10.0000000
To Sine Meridian ∠	67	26	33	9.9654345
So Coſine Altitude Mid-Heaven . .	31	48	15	9.9293445
To Coſine Altitude 90th Degree required	38	17	40	9.8947790

☞ Then you may proceed to find the Place of the 90th Degree of the Ecliptic, or its Diſtance from the Mid-Heaven Longitude, THUS, *As Radius to Coſine Altitude Mid-Heaven,*
So Coſine Merid. Angle to Tan. Diſt. Mid-Heaven from the 90th Degree. Which Place is found by adding the Diſtance to, or ſubtracting it from the Diſtance of the Mid-Heaven, according as its Place follows or precedes the Place of the Mid-Heaven.

Viz, If the Mid-Heaven be in { ♑, ♒, ♓, ♈, ♉, ♊, add / ♋, ♌, ♍, ♎, ♏, ♐, ſubtract } the Diſtance of Mid-Hea. fr. 90° to and from the Place of Mid-Heaven, for the Place of the 90th Degree, in North Latitudes, and do the contrary in South Latitudes.

Then the Point of the *Aſcendant* has been uſually found, or the Ecliptic Place at the Horizon, at a given Time, for the Purpoſe of finding the *Parallactic Angle,* or that Angle which a Vertical (paſſing through the *Sun, Moon,* or *Star*) makes with the Ecliptic, for computing ECLIPSES and OCCULTATIONS.

But as theſe Methods are tedious and obſolete, we give the following UNIVERSAL NEW METHOD *of finding the* PARALLACTIC ANGLE, *and of computing the* MOON's PARALLAXES.

XXXIX. QUESTION. *To find the* apparent *Place of the* Moon, *from her Longitude, or true Place, and Latitude given?*

Find the ☽'*s Declin. and R. A.* (by Queſt. XXVII. and XXVIII.) *anſwerable to the* Longitude *and* Latitude *given; for in a Spherical Triangle* APE, *there are given* AE *the Complement of Latitude;* PE, *the Diſtance of the Poles of Equator and Ecliptic; and* ∠ E, *the Longitude from* ♋ *or* ♑, *the Solſtitial Colure, to find* AP *the Complement of Declination, and* ∠ P, *the Right Aſcenſion from* ♑ *or* ♋?

Or take out the Declination and Right Aſcenſion to the Time given, from *Ephemerides, De la Caille's, Connoiſſance des Temps, &c.* reduced to *Greenwich*-Meridian.

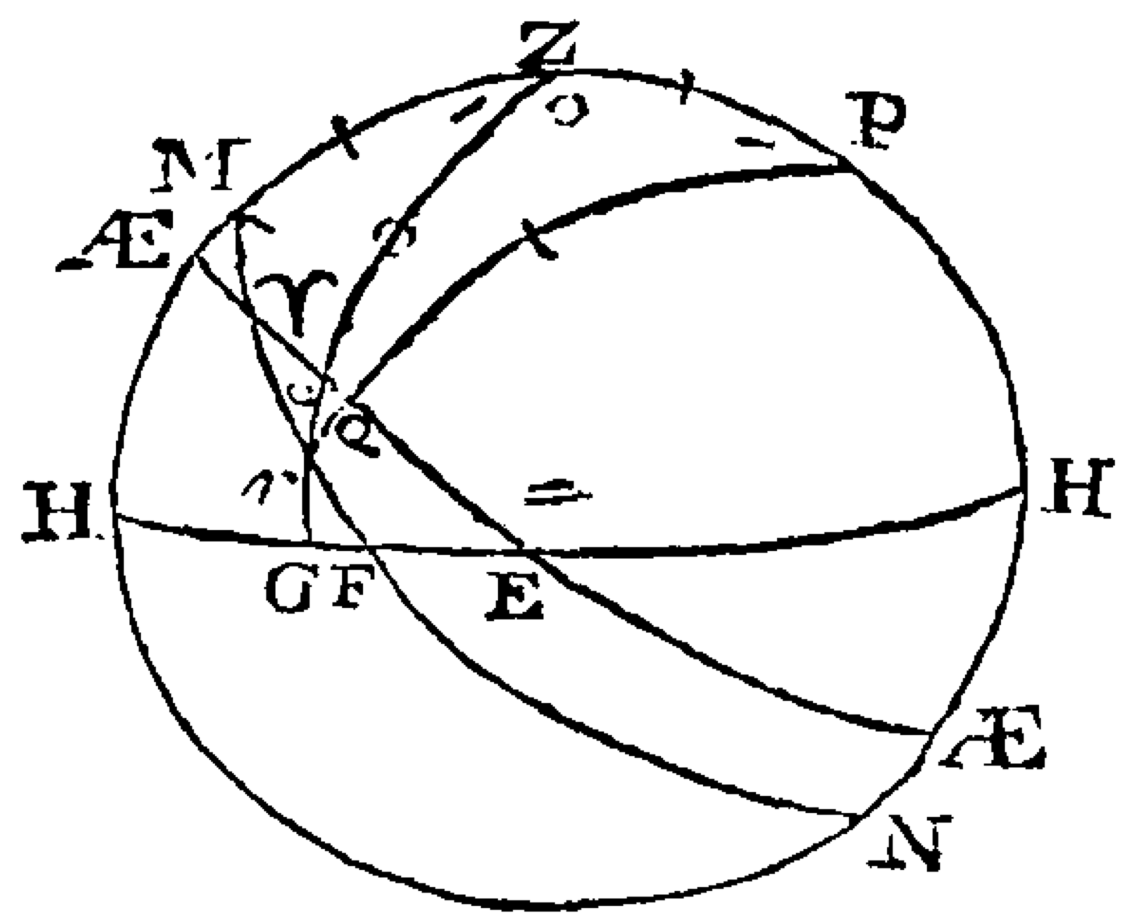
EXAMPLE. *To find the Moon's apparent Place from the true,* ♓ 11° 10′ 44″, *for the Year* 1737, February 18d 2h 25m 9s *apparent, or* 2h 38m 36s *mean Time, Afternoon, O. S. about the Beginning of the ſolar Eclipſe, obſerved at* Greenwich.

		°	′	″
The Sun's Longitude then	♓	11	6	55
His Right Aſcenſion correſpondent		342	34	48
—— Declination correſpondent S.		7	24	28
Moon's Longitude then, by Theory, ...	♓	11	10	44
——— Latitude N.		0	37	40
——— Declination correſpondent S.		6	48	11
——— Right Aſcenſion correſpondent		342	23	56
Time from Noon apparent, in Degrees, 36° 17′ 15″. Hence R. A. of Mid-Heaven		18	52	3
Mid-Heaven Declination correſpondent N. . . .		7	59	40
Altitude of Mid-Heaven at *Greenwich* . . .		46	31	10
Mid-Heaven Zen. Diſt. from the Ecliptic Altitude at the Meridian		43	28	50
Mid-Heaven R. A. — Moon's R. A. is the Moon's Angular Diſt. fr. the Meridian, paſt . .		36	28	7
Angle of Ecliptic and Meridian, to R. A. Mid-Heaven, or Mid-Heaven Longitude		67	51	20

Firſt to find the Moon's Altitude and Azimuth?

In the Fig. are given. { ZP = 38° 31′ 30″ Comp. Latitude,
QP = 96 48 11 Comp. Moon's Declination,
∠QPZ = 36 28 7 Moon's angular Diſt. fr. Meridian.

To find QZ = Comp. Altitude? And ∠ QZP = the Moon's Azimuth from the North?



N. B. *The Line* PQ *terminates in* ZG, *above the Interſection of* MN *and* ZG, *between* r *and* o.

PROPORTION.	°	′	″	*Logarithms.*
As Radius . . . . S.	90			10.0000000
To Coſ. angular Diſt. from Meridian ∠ QPZ	36	28	7	9.9053547
So Tan. Comp. Lat. ZP	38	31	30	9.9009941
To Tan. 4th Arc	32	37	46	9.8063488
☽ *Decl. and Lat. Place of diff. Name.* } Add	83	11	49	Comp. Decl.
5th Arc . : Sum	115	49	35	or 64 10 25 [S.

N. B. Subtract the 4th Arc from ~~the Coſine Declination~~ polar dist for the 5th Arc, when the Declination and Latitude of the Place are of a different Name.

	°	′	″	
As Coſ. 4th Arc	32	37	46 co.	0.0745974
To Coſ. 5th Arc	64	10	25	9.6391334
So Coſ. ZP or S. Latitude . .	51	28	30	9.8933936
To Coſ. Alt. QZ or S. Alt. QG . . .	23	52	19	9.6071244
NOW, As Coſ. Alt. GQ or S. QZ .	66	7	41 co.	0.0388390
To S. ☽ Ang. Diſt. fr. Mern. ∠QPZ	36	28	7	9.7740658
So S. Diſt. from Pole QP . . .	96	48	11	9.9969314
To S. ☽'s Azim. from the S. } . . ∠MZQ	40	11	48	9.8098362

Here, *In the Spherical Triangle* MZr, *the* ∠ MZr, ∠rMZ, *(Supplement of* ∠ *of Mid-Heaven Ecliptic, and Meridian) with the included Side* MZ, *the Zenith Diſtance of the Mid-Heaven Ecliptic, to find the* **Parallactic Angle,** *or* ∠ MrZ, *that the Vertical* ZG *paſſing through the Moon's Center, makes with the Ecliptic* MN, *without having Regard to the* ∠ HFM, *of the Horizon and Ecliptic, commonly called the Altitude of the* Nonageſimal *or* 90*th Degree of the Ecliptic, to which that Angle of the Horizon and Ecliptic is equal?*

PROPORTION.

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* PROPORTION and LOGARITHMS.

PROPORTION.				*Logarithms.*
As Radius . . . . S.	90°			10.0000000
To Cos. Zen. Dist. of Mid-Heaven (MZ)	43	28	50	9.8607020
So Tan. Azim. (∠ Z)	40	11	48	9.9268392
To Cot. of an ∠ with the Merid. the 1st Part of the Supplement of the Merid. ∠ rMZ, by a Perp. fr. M. to r Z	58	29	13	9.7875412
Supplement Merid. ∠	112	8	40	
Remaining ∠	53	39	27	
And, As S. First Part of the Supplement Meridian ∠	58	29	13 [co.	0.0692948
To S. remaining Part of the Supplement Meridian ∠	53	39	27	9.9060595
So Cos. Azimuth (∠ Z)	40	11	48	9.8829988
To Cos. PARALLACTIC ∠ by the Vertical and Ecliptic, the ∠ MrZ, required.	43	48	20	9.8583531

Thus the Trouble and Attention of finding the Altitude *and* Longitude *of* 90° *of the Ecliptic are avoided.*

OTHERWISE,

By DEAN COWPER's *compendious* METHOD; being *one of the* IMPROVEMENTS *of Astronomy in this last Age.*

The Dean of *Durham* proceeds to find the ☽'s Alt. by the former Method exhibited; who (instead of finding the Azimuth QZP) next finds the ∠ ZQP, which he calls the ∠ at the Center. " *This Angle at the Center is the same with that which the Axis of the Earth makes with a* vertical *Circle drawn through the Center of a Place in the Projection of the Progress of the lunar Path over the Earth's* Disk, *or Plane of the Horizon: The Complement of the* Sum, *or* Difference, *of which Angle, and the Angle of the* Poles *of the Ecliptic and Earth, on the said Projection, (according as the* Pole *of the Ecliptic, and* Vertical, *passing through the Moon's Center, fall on* different *Sides, or on the* same * Side, *of the Meridian, or Earth's Axis, respectively) is the* Parallactic Angle."

See Palladium 1756, p. 35. for the Explanation of this useful Discovery, by Dean COWPER.

To find ∠ ZQP, or ∠ at the Moon's Center?

As Cosine Altitude ☽, or S. Zen. Dist.	66°	7′	41″ co.	0.0588390
To ang. Distance fr. Mer. ∠ QPZ	36	28	7	9.7740658
So Sine Pole from Zenith . . .	38	31	30	9.7943877
To Sine ∠ at Center ZQP . . .	23	52	54	9.6072925
∠ of Poles of the Earth and Ecliptic	22	8	40	Comp. Merid. ∠ [at Mid-Heaven.
Complement of Paral. ∠ . . . *Sum*	46	1	34	
Its Complement is	43	58	26	the Parall. ∠ reqd

according to D. *Cowper's* compendious Method. Which is *accurately* true, when the Comp. of the ∠ of a *Vertical*, passing through the ⊙ or ☽, and a Circle of Declination is taken instead of the Complement of Meridian Angle at the Mid-Heaven; when there is no *Latitude*; and in other Cases of small Latitude, is a very useful *Approximation*, as will appear further on.

☞ *In Order to find the* Parallactic ∠ *correctly, by the universal new Method, the Meridian* ∠ *must be always taken at the Mid-Heaven Point of the Ecliptic, and not from the Sun or* ☽*'s Place, or Longitude, at the given Time of an Observation of an Eclipse or Occultation, according to the Table of the Meridian* ∠, *which* ∠ *only respects the Sun's Pl. at Noon, or the Mid-Heaven* Long. *Whereas an* ∠ *correspondent to* Sun *or* ☽*'s present Longitude taken from the Table of Meridian* ∠ (p. 23.) *is an* ∠ *that the Ecliptic makes with a Circle of Declination at that Time.* This Angle (and not the Meridian Angle) *is therefore to be used with the* Angle *at the Moon's Center; whose Difference is the* parallactic Angle, *according to Dean* Cowper*'s improved compendious Method.* For, when the *Point* Q (now having small Latitude) *coincides* with the *Point r* in the Ecliptic, then it is *evident* that the ∠ MrP of the Ecliptic Mr, and Circle of Declination rP, will contain the Sum of the PARALLACTIC ANGLE and the Angle that the same Circle of Declination rP, at the *Sun* or *Moon*, makes with the *Vertical*, QZ; therefore from which ∠ of the Ecliptic and Circle of Declination, taking away the ∠ of the *Vertical*, passing through the *Sun* or *Moon*, and same Circle of Declination ZrP, and the PARALLACTIC ANGLE, MrZ, will then *evidently* remain; *which is therefore* D. COWPER's *improved compendious Method of finding the Parallactic Angle.*

	°	′	″
Thus, the Moon's Longitude at the aforesaid Time of *Observation* of the ECLIPSE beginning at *Greenwich* is ♓	11	10	44
Correspondent to which the ∠ of Ecliptic and Circle of Declination MrP, by *Tab. p.* 23, is . . .	67	39	15
From which last ∠ MrP take away the ∠ ZQP of the Vertical and Circle of Declination, as before found	— 23	52	54
Then will remain the PARALLACTIC ∠ by Dean *Cowper's* improved compendious *Method* . . .	43	46	21
By the UNIVERSAL NEW METHOD . .	43	48	20
How small the *Difference!*	— 1	59	[Error.

REMARK. The ∠ of the Poles of the Earth and Ecliptic being always the Complement of the ∠ of the Ecliptic and Circle of Declination, whether less or more than 90°, *(evident by Projection)*. Therefore when either the *Sum* or *Diff.* of the ∠ of the † Poles and ∠ of the Center, or Vertical and Circle of Declination, according to D. *Cowper's* compendious Method, is equal to the Complement of the ∠ of the Ecliptic and Vertical, it is plain from thence, that the Angle of the *Center* (so called) or ∠ of the Vertical and Circle of Declination being taken from the Angle of the Ecliptic and said Circle of Declination (commonly called the *Meridian* ∠) will leave the ∠ of the Ecliptic and Vertical, called the *Parallactic* ∠, as aforesaid, according to D. *Cowper's* improved compendious Method.

For, Let M = ∠ of Ecliptic and Circle of Declination.
Then, 90° — M = ∠ of the Poles of Ecliptic and Earth.
C = ∠ at the Center or Vertical and Circle of Declination.
And, C ± 90° ∓ M = Complement *Parallactic* ∠.
Hence, 90° — C ∓ 90° ± M = *Parallactic* ∠.
i. e. In 1st Case M — C = *Parallactic* ∠.
Second Case 180° — $\overline{M + C}$ = *Parallactic* ∠.

Or since, in the 2d *Case*, M is greater than 90° (which only happens when the Longitude is from ♋ to ♑) therefore
90° — 180° + M = ∠ of the Poles of Ecliptic and Earth.
Viz. — 90° + M.
And, C + 90° — M = Compt. *Parallactic* ∠.
Wherefore 90° — C — 90° + M = *Parallactic* ∠, = M—C.
Hence, *Universally*, M — C = the Parallactic Angle.
Or, Comp. M — C = Comp. Par. ∠ according to D. *Cowper*.

N. B. *You must use the Supplement of the Meridian Angle in Table p.* 23. *from* ♋ *to* ♑; *in all other Places take out the Angle as by Table.*

NOW, With the Moon's mean Anom. to the Time given	11s	8°	54′
Find (by *Tab. p.* 78) ☽'s *Horizontal Parallax*	0	54	18
Correspondent to which the *Horiz. Semi-Diameter* . .	0	14	56

By PROPORTION.

For Parallax in Altitude.

As Radius	90°	0′	0″	10.0000000
To Sine Hor. Parall.	0	54′	18	8.1985079
So Cosine ☽'s Altitude	23	52	19	9.9611610
To Sine ☽'s *Parallax* in Altitude . .	0	49	39	8.1596689
Subtract from true Altitude	23	52	19	
☽ visible Altitude	23	2	40	required.

N. B. * ⊙ in ♋ ♌ ♍ ♎ ♏ ♐ / ♑ ♒ ♓ ♈ ♉ ♊ { Axis of Ecliptic } Left / Right { of the Earth's *Axis*. }

† For the ∠ of the Poles of Ecliptic and Earth?
As Radius to Cosine present Longitude ⊙, *or* ☽ *near the Ecliptic.*
So Tan. 23° 28′ 30″ *to Tan.* ∠ *of the Poles, correspondent.*

For

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* PROPORTION and LOGARITHMS.

For the Parallax in Longitude.

	°	′	″	*Logarithms.*
As Radius	90	0	0	10.0000000
To Tan. Par. in Alt.	0	49	39	8.1596689
So Cosine *Parallactic* ∠	43	48	20	9.8583531
To Tangent Parallax in Longitude	—	35	40	8.0180220
Add *in the East* and *subtract in the West Quadrant of Ecliptic for visible Long.*	♓ 11	10	44	☽ true Long.
☽ *visible* Longitude	♓ 10	34	54	*required.*

For the Parallax in Latitude.

	°	′	″	
As Radius	90	0	0	10.0000000
To Sine ☽'s Parallax in Altitude	0	49	39	8.1596689
So Sine *Parallactic* ∠	43	48	20	9.8402598
To Sine Parallax in Latitude		34	23	7.9999087
Sub. from True Latitude ☽ N. D.		37	40	
Visible Latitude ☽ N.		3	17	*required.*

☞ In computing the Moon's Parallax, by Dean *Cowper's short Method*, for the Time of ECLIPSES of the Sun, the *Moon's* Right Ascension may be taken the same with the Sun's, without sensible Error. And if, instead of the absolute *horizontal Parallax* of the Moon, you take the *Excess* of the Moon's horizontal Parallax, above that of the Sun, *you will have the Parallax of the Moon from the Sun, in Altitude, Longitude and Latitude.*

The *Old Method* of finding the *Parallactic Angle* (from whence the Parallaxes in Altitude, Longitude and Latitude are had) is thus,

The Altitude and Longitude of the Nonagesimal or 90 Degree of the Ecliptic from the Horizon, being computed by Rules before delivered, or found from *Tables*, on Purpose, for a given Latitude.

Say, As *Radius to Cosine Dist.* ☽ *from the* 90° *of Ecliptic,*
So is *the Tang. Alt.* 90° *to Tang. 4th Arc.*

This Arc taken from the Complement ☽'s Latitude, or Distance from the North Pole of the Ecliptic, leaves a 5th Arc.

Then, As *Cosine 4th to Cosine 5th Arc,*
So is *Cosine Altitude* 90° *Ecliptic to Sine* ☽*'s Altitude.*
And, As *Cosine* ☽*'s Altitude to Sine Dist. from* 90° *Ecliptic,*
So is *Sine Altitude* 90° *to Cosine* Parallactic ∠ sought.

But this *old Method* is far exceeded by Dean *Cowper's* new and compendious One, before delivered; which however is here given Place to for the *practical* Astronomer's Satisfaction, that he may compare the *different Methods*, and choose the best.

☞ Mr. *Dunthorne*, in his Astronomy, *p.* 63, recommends the finding the Angle, at the Moon's Center, which the *Vertical* makes with a Circle of Latitude, and thence the Moon's Parallax, in *Longitude*, and *Latitude*, which he says is the *more* exact. By this we apprehend, that Mr. *Dunthorne* directs us to find the Angle that the Moon's Orbit makes with the *Vertical* Circle at the Moon's Center. But since the Longitudes and Latitudes of the *Sun*, *Moon*, and *Stars*, refer to, or are computed to the Ecliptic, the *Parallactic Angle* and all the Parallaxes of *Longitude*, *Latitude*, &c. derived therefrom, must have also Reference to the same Ecliptic, and not to the *Lunar Orbit*. For it is not the Orbit but Ecliptic Place of the Moon we compute from.

And a Solar Eclipse 18th Feb. 1737, being computed by the Operose Method in *Leadbetter's Uranoscopia*, from *p.* 147 to *p.* 153, *viz.* for finding the Meridian Angle, culminating Point of the Ecliptic, Alte of Mid-Heaven, Nonagesimal Degree, &c. in the Lunar Orbit, the same Eclipse was also computed with the same Requisites in the Ecliptic; the Eclipse by the last Method was found to come *nearest* to Observation.

Likewise in the Examples of the Use of Dr. *Halley's* Tables (d, d 2) the Nonagesimal Degree and *Parallactic* Angle at the Moon (*i. e.* corresponding to the Moon's Place) are both taken in the Ecliptic (and not in the Lunar Orbit) tho' the Moon had almost 5 Degrees of Latitude; which our *universal Method* of finding the *Parallactic* ∠, allows for.

To apply the Parallaxes *to the computed Places of the Moon by the Tables.*

RULES.

1. When the Moon is to the *East* of the 90° of the Ecliptic, the *Parallax* in *Longitude* must be *added* to the true for the visible Longitude; but when she is to the Westward thereof it must be *subtracted* from the true for the visible or apparent *Longitude*.

2. The above *Rule* holds good for *Right Ascensions*, according as the Moon is to the East or West of the Meridian of the Place of Observation.

3. The *Parallax in Latitude* being *added* to the true Distance of the Moon from the Pole of the Ecliptic, which is *nearest* to the Vertex of the Place of Observation, will give the apparent or visible Distance of the Moon from that Pole, whence it will appear, whether this Parallax is to be *added to*, or subtracted from the true Latitude for the apparent. But between the *Tropics*, where the Ecliptic is vertical once in 24 Hours, at such Times *it is* always to be *added* to the true for the apparent Latitude.

4. In like Manner, the *Parallax in Declination* being added to the true Distance of the Moon from that Pole of the Equator, *nearest* to the Vertex of the Place of Observation, will give the apparent or visible Distance from the Pole. Whence it will *appear* whether this Parallax is to be added to or subtracted to or from the true for the apparent Declination. But in Places on the Globe which have no Latitude, the Parallax in Declination is always *additive* to the true for the apparent Declination.

The NAVIGATOR *being* Master *of applying the* MOON'S PARALLAXES, *the Longitudes betwixt Places on the Globe, may be determined by observing the Moon's Appulses to a fixed Star, or her Distance from a fixed Star, lying near the Parallel of Latitude where the Moon then is (to avoid the Effect of Error in the Moon's computed Distance from the Star, resulting from computed Error of her Latitude) or else by the Distance of the Moon from the Sun in the first or last Quarter. From any of which Observations, the Latitude of the Place, and Time of an Observation being known, the Distance of the present Meridian of the Place from that of* Greenwich, *is discovered by finding the correct Time at* Greenwich, *from* our Tables, *when such* Phœnomena *could happen: The* Difference *of which Times being turned into Degrees (allowing* 15° *to an Hour) will shew the Distance of the two Meridians of those Places from each other, required.* Which METHOD, with necessary *Examples* we have exhibited further on.

PARALLAXES determined from EPHEMERIDES: *Relative to the* PRECEDING QUESTION *of the* PARALLACTIC ANGLE, *and also to* TABLE p. 215, *of the* EQUATION *of the Moon's Horizontal Diameter to the Moon's Diameter in Altitude.*

XL. QUESTION. *To find the true from the apparent or visible Altitude of the Moon?*

EXAMPLE I. Suppose the apparent Altitude of the Moon's Center at *Paris*, 6th *October* 1761, at 9h 53m Night, to be 27° 37′ 4″, what will be the Moon's true Altitude at that Time?

☽'s Hor. Parallax.

1761 *Oct.* 6 Noon { 55′ 2″ } De la Caille's *Ephemerides.*
11 Noon { 54 40 }

If 5 Ds. decreases 22″ : : 9h 53m : Decr. 1″ 49‴, or 2″
55′ 2″
— 2

Hor. Par. 55 0, at 9h 53m Night.

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* PROPORTION and LOGARITHMS.

PROPORTION.

				Logarithms.
As Radius S. at 9^h 53^m Night . . .				10.00000
To Sine Hor. Parallax	0°	55′	0″	8.20407
So Cosine apparent Altitude	27	32	4	9.94779
To Sine Parallax in Altitude . . .	+	48	46	8.15186
Contrary to reducing the true to the visible Altitude, add Par. in Altitude to,	27	32	4	☾'s appt. Altitude.
☽'s true Altitude	28	20	50	required.

EXAMPLE II. If the Altitude Moon's upper Limb was observed to be 27° 47′ 25″ at that Time.

	Sine Comp.			9.94677
PROPOR. S. Horiz. Parallax . . . as before.	0°	55′	0″	8.20407
S. Horiz. Parall. of the Moon's upper Limb	0	48	39	8.15084
Add the Parallax of ☽'s upper Limb to .	27	47	25	appt Alt. ☽ upperLimb.
True Altitude ☽'s upper Limb . .	28	36	4	
☽'s Semi Diameter * at that Time, corrected by *Table p.* 215.	—	15	0	
True Altitude of ☽'s Center . . .	28	21	4	remains.

* *La Caille's* Ephemerides.

XLI. QUESTION. *To find the Moon's Parallax correspondent to her true Altitude given, and to reduce her true to her apparent Altitude?*

EXAMPLE. 28° 20′ 50″ ☽'s true Altitude to find her Altitude apparent?

PROPORTION.

As Radius	90°	0′	0″	10.00000
To Sine Hor. Par.	0	55	0	8.20407
So Cosine true Altitude	28	20	50	9.94452
To Sine of certain Parallax . . .	0	48	24	8.14859
Complement true Altitude	61	39	10	
Again, As Radius				10.00000
To Sine of Comp. true Alt. augmented by certain Paral. found . . .	62	27	34	9.94777
So S. Hor. Paral.	0	55	0	8.20407
To Sine Parallax required	0	48	46	8.15184
Subtract from true Altitude ☽	28	20	50	
Remains ☽'s apparent Altitude . .	27	32	4	required.

☞ *Thus the Methods of finding the* Parallaxes *for the* true *and* apparent *Altitudes are accurately distinguished; their Quantities having contrary Signs,* — and +.

The PRECEPT WRITER *to Dr.* Halley's *Tables (Mr.* G. Morris) *after truly observing that the Parallax in Altitude is always as the Sine of the apparent Distance from the Vertex, bids you increase the true Distance from the Vertex by Guess, to find the Parallax answerable to the apparent Altitude, instead of* using *the true Method above.* Who says further, "*If the true Distance from the Vertex be taken for the apparent, and the* Parallax *in Altitude be found from it, that true Distance being increased by this Parallax may be taken for the apparent; and the* Parallax *thence found will be very near the Truth.*

But surely Mr. *Morris* could not take the foregoing RULE from the accurate Dr. *Bradly*; seeing, in the foregoing Instance, that it's Error is 22″ of a Degree, a greater Error than the said *Precept* and *Preface Writer* to Dr. *Halley's* Tables, has detected in that Author, by his using the apparent instead of the true Diameter of the Moon, for reducing the ☽'s apparent Right Ascension and Longitude observed to her true Right Ascension and Longitude of her Center, from the Earth's Center.

Which Preface Writer takes Notice that it has occasioned an Error in the Places of the Table intitled *Lunæ Meridianæ* of 15″; but seldom exceeding that Quantity.

☞ An Instance of reducing the apparent or observed Place of the Moon from the Earth's Surface, to her correct Place from the Earth's Center, will be shewn in the *Precepts.*

XLII. QUESTION. *To find the Moon's Distance from the Center of the Earth, at any Time?*

PROPORTION.

As Sine ☽'s present Parallax in Altitude	0°	48′	46″ co.	1.848165
To Cosine ☽'s present Altitude . .	27	32	4	9.9477929
So the Sem. Diameter Earth . .	1	0	0	0.0000000
To the No. of the Earth's Semi-Diameters from ☽ to the Earth's Cen.	62,511, &c.			1.795958

By the same *Rule*, the *greatest Distance* of the MOON is found, as follows.

As Sine *least* Hor. Parallax . .	0°	53′	29″ co.	1.8080729
To Cosine Altitude 0° *viz.* S. 90° or Radius . .				10.0000000
So the Semi Diameter Earth	1 .			0.0000000
To the No. of Earth's Diameter from ☽ to the Earth's Center	64,279 the *greatest* Dist.			1.8080729

Likewise the *least* Distance thus.

As Sine *greatest* Hor. Parallax . .	0°	61′	7″ co.	1.7573011
To Rad.	S. 90	0	0	10.0000000
So the Semi Diameter of the Earth 1	.	.		0.0000000
To the No. of Earth's semi Diameters from ☽ to the Earth's Center	57,188			1.757,3011

the *least* Distance.

☞ *The Distances of the Sun and Planets are found from their Parallaxes by the same Rule.*

64,297 greatest Dist.

121,485 Sum.

Earth's Semi-Diameters ½ 60,742 Mean Dist. ⊖ from the Moon.

XLIII. QUESTION. *To find the true Horizontal Diameter of the Moon?*

You may measure it at Full Moon by the *Micrometer*, from Observation. Or you may compute it by observing the Time the full Moon takes up in passing the Meridian, on a given Circle of Declination, as follows.

PROPORTION.

As the *Interval* of Time betwixt the Moon's two next Passages through the same Meridian, *is* to the *Interval* of Time *observed*, of the Passage of the Moon's whole Disk, or *West* and *East* Limbs, over the same Meridian, *so is* 360° to the *Minutes* and *Seconds* of *Equator* passing the Meridian while the Moon passes it.

Again, As *Radius* is to *Cosine* of the Moon's Declination, at that Time, *so are* the Minutes and Seconds of the Equator passing the Meridian, while the Moon passes it, *(before found)* to the *Minutes* and *Seconds* of the Moon's true *Horizontal* Diameter *required.*

☽ passes *Paris* Mer. at Night.

EXAMPLE. 1763, 21 Oct. { 12^h 2^m } And suppose ☽ 2^m 3^s in
De la Caille's Ephem. 22 . { 12 44 } passing the Merid. 21st.

Interval ☽ from Merid. to Merid. 24 42

Say, As 24^h 42^m a Lunar Day : 2^m 3^s :: 360° : 29′ 53″. of the Equator.

☾ Decl. 21 Oct. Noon } 9° 36′ { Whence Declination 12° 15′ at
22 Noon } 14 51 { 12^h 2^m Night Middle of passing, 21st Oct.

Astronomical QUESTIONS (in PRACTICE) answered by *Spherical* PROPORTION and LOGARITHMS.

			Logarithms.
Again As Radius,	S.	90° 0′	10.0000000
To Cosine ☽ Declination at that Time		12 15	9.9899973
So 29′ 53″ or Mot. of Equator	S.		7.9391497
To 29′ 12″ or S.	S.		7.9291470
The ☽'s true Horizontal Diameter required.			

M. *De la Caille* has the Sem. Diameter of the Moon, 14′ 48″ ½ or 29′ 37″ the Diameter. *See his Ephem.* 1763, Oct. 21. N. S. differing from his own Example by 25″ Horizontal Parallax ☽ then 54′ 46″

N. B. *The Sines of small Arcs are nearly the same as those Arcs.*

☞ *After the same Manner are correctly computed the true Diameter of the Sun and of each of the Planets.*

XLIV. QUESTION. *To find the Inclination or Angle of the Moon's Orbit and Equinoctial, from the Longitude of the Moon's Node being given, ♋ 0° 0′?*

Universal PROPORTION.

As Radius	Sine 90°	0′	0″	10.0000000
To Cosine Declination, correspondent to the Longitude ☊ from ♈ or ♎,	23	28	30	9.9624801
So Sine Diff. betwixt the Incl. of the Ecl. with ☽'s Orb and Mer. ∠ fr. ☊ in ♑. to ♋ (but S. *Sum* of said Incl. and Merid. ∠ fr. ☊ in ♋ to ♑) *viz.* in this Case S.	85	0	25	9.9983488
(Inclin. ☽'s Orb. with the Ecliptic being	4	59	35)	
To Cosine ∠ of the ☽'s Orb with the Equinoctial required	23	58	15	9.9608289
Leadbetter in his Astron. 2 vol. makes it (*Tab. p.* 71)	23	29	0	∠ of Ecliptic and Equi. for ☽'s Orb. & Eq.
	29	15		his Error.

EXAMPLE II. *To find the* Inclination *of the Moon's Orb with the Equinoctial, when the Longitude of the* ☽'*s Node is* ♌ 2°?

As Radius	Sine 90°	0′	0″	10.0000000
To Cosine Declination correspondent to Longitude ☽'s ☊	19	44	39	9.9736867
So S. *Sum* of the Inclination of Ecliptic and ☽'s Orb. and Meridian ∠, *viz.* Sine	82	6	51	9.9958735
(Angle Inclination with Ecliptic, being and Meridian ∠ 77° 2′ 23″)	5	4	28	
To Cosine ∠ of the ☽'s Orb. and Equinoctial required	21°	12′	8″	9.9695602
Leadbetter in his Astron. 2 vol. makes it (*Tab. p.* 72)	21	36	10	
	+ 24	2		his Error.

Greatest ∠ of Ecliptic with the Moon's Orbit ☊ in ♈ and ♎	5°	17′	20″
∠ of the Ecliptic and Equinoctial in all Positions of the ☽'s ☊	23	28	30
Greatest and least ∠ of the ☽'s Orb with Equin. ☊ in ♈	28	45	50
♎	18	11	10
			correctly.

The two last *Instances* of the Inclination of ☽'s Orb with the Equinoctial, are the only two, wherein *Leadbetter*'s Tables, p. 71 and 72, are true, in all the 180 Operations; however he came to be mistaken in the Rules of so essential a Point of *Computation.*

XLV. QUESTION. *To find the Time from Noon of the Conjunctions (or any other Aspect) of the Moon with the several* Planets, *from the Difference of Diurnal Motion of the Moon, and of any* Planet, *and the Distance of the Moon from the Conjunction or other Aspect of that Planet at Noon, (less than* the given Difference of Diurnal Motions) *being given?*

According to M. *De la Caille*'s Ephem. for *Paris.*

1764 October 23. ☽'s Longitude Noon	7° ♎	54
24	22	44
☽'s Diurnal Motion	14	50
Sub. Place ☽ 23 Oct. from Place ♀ 23 Oct. for their Dist fr. Conj. — 23 ♀ Longitude Noon	15 ♎	44
24	15	55
♀'s Diurnal Motion	0	11
Difference Diurnal Motion ☽ à ♀	14	39
Dist. ♀ before ☽ 23d October Noon *viz.* fr. both in the same Sig. and Degree	7	50

N. B. *Always subtract the Place of the swifter from the Place of the slower Body, for their Distance, in proportioning the Time required for the swifter overtaking the slower Body, from their Difference of Motions.*

RULE. *As Difference of Diurnal Motion of the Moon and any Planet, in Degrees and Minutes, is to 24 Hours, so is the Distance of the Moon from any Planet* (or other Aspect) *at Noon, in Degrees and Minutes* (less than the said Difference of Diurnal Motions) *to the Hour and Minute forward from that Noon, when the Conjunction* (or other Aspect) *of the Moon with that Planet happens.*

Thus,

			Lo. Log.
As Difference Diurnal Motion ☽ à ♀	14°	39′ co.	9.3877
To 24 Hours			0.3979
So Distance of ♀ before ☽ at Noon 23d Oct.	7	50	0.8842
To Time of Conjunction ☽ ♀ past Noon 1764 October 23.	12^h	50^m	0.6698

Oct. 24th 50^m Morning, *Paris.*

DECIMALLY.

As 14° 39′ to 24^h = 14,65 So 7° 50′ to 12^h 50^m =7,833 . by 6 } 46,998 . by 4 } =24

14,65)187,992(12^h,83=12^h 50^m *fere*, past Noon at *Paris*, or 12^h 40^m 40^s at *Greenwich.*

```
1465 . .
----
 4149
 2930
----
 12192
 11720
----
  4720
  4395
----
rem. 325
```

N. B. M. *De la Caille* (by Inattention) made the Conjunction of the ☽ and ♀ to happen on 21st Oct. 1764, instead of on 24th, as above. *See his Ephemerides for that Year*; Col. Des Phenomenes & Observations, p. 255.

☽'s Latitude at the Time of the above Conjunction	1° S.	50′
♀ Latitude then	1 N.	16
Sum	3	6

Consequently the Moon passes under *Venus* in the said Time of *Conjunction*, at the Distance of 3° 6′. For whatever Planet has most Northern Latitude, or is nearest to our elevated North Pole, is the uppermost or superior Planet, when any two Planets happen in Conjunction, or in the same Sign of the Ecliptic.

Aſtronomical QUESTIONS applied to PRACTICE.

Operation *of the* **Latitudes.**

	Moon's Lat.		♀ Lat.
1764 Oct. 23	1° S. 9′	. . .	1° N. 9′
24	2 25	. . .	1 22
As 24ʰ to	1 16	As 24ʰ to	0 13 Difference.
So 12ʰ 50ᵐ to	0 41	So 12ʰ 50ᵐ to	0 7 To add to 1ſt Lat.
☽'s Lat. 24 D.	1° S. 50′		1° N. 16′ ♀ Latitude.

The Conjunction of the Planets with one another are found in the ſame Manner. And the other Aſpects *of the* Moon *with the ſeveral Planets, and Planets with one another, are found in the ſame Manner alſo, by proportioning the Diſtance of the Moon or Planet from its* Trine, Quartile, Sextile, *or* Oppoſition, *at Noon, viz. from* 120°, 90°, 60°, *or* 180° *reſpectively diſtant from one another at Noon.*

Example. II. *To find the Time of the firſt Planetary Oppoſition with the Moon in* April 1764?

Examining *Ephemerides* for *Paris* by *De la Caille*.

The firſt Sign of the Moon having Oppoſition by a Planet, is the ☽ in ♊, and ♂ in the oppoſite Sign ♐.

1764 *April* 6, ☽'s Longitude at Noon . .	12° ♊ 16′	
7	24	24
☽'s Diurnal Motion	12	8
Sub. ☽'s *Place April* 6, *From* ♂'s *Place April* 6, *for their Diſt. fr. Oppoſit.* — 6 ♂ Longitude at Noon . .	15 ♐	11
7 ♂ Longitude at Noon .	15	25
♂ Diurnal Motion	0	14
Difference Diurnal Motion ☽ à ♂ . .	11	54
Diſtance of ☽ from an *Oppoſition* with ♂ at Noon, *Apr*, 6, *viz.* from an oppoſite Sign and Degree.	2	55

		Lo. Log.
Now, As Difference Diurnal Motion ☽ à ♂	11° 54′ co.	9.2974
To 24 Hours		0.3979
So Diſt. ☽ and ♂ fr. Oppoſition Apr. 6th 1764.	2 55	1.3133
To Time Oppoſition ☽ ♂ paſt Noon 1764 Apr. 6. 5ʰ 53ᵐ at *Paris*, or 5ʰ 43ᵐ 40ˢ at *Greenwich*.		1.0086

Decimally.

As 11° 54′ to 24ʰ ſo 2° 55′ to 5ʰ 53ᵐ
= 11°,9 = 2°,916 by 6 } = 24
17,496 by 4 }
11°,9)69,984(5ʰ,88 = 5ʰ 53ᵐ paſt Noon at *Paris*, or 5ʰ 43ᵐ 40ˢ at *Greenwich*.
595 ..
1048
952
964
952
Rem. 12

☞ *In the ſame Manner you are to proportion the Diſtance of the* Moon, *or ſwifter moving Planet, from any* Aſpect *of another Planet at Noon: The Aſpects of the Moon, with all the Planets, and each with one another being diſcoverable at Sight, by the annex'd Scheme, or Figure; which is particularly neceſſary for finding the Oppoſitions of the Sun and any of the Stars or Planets.*

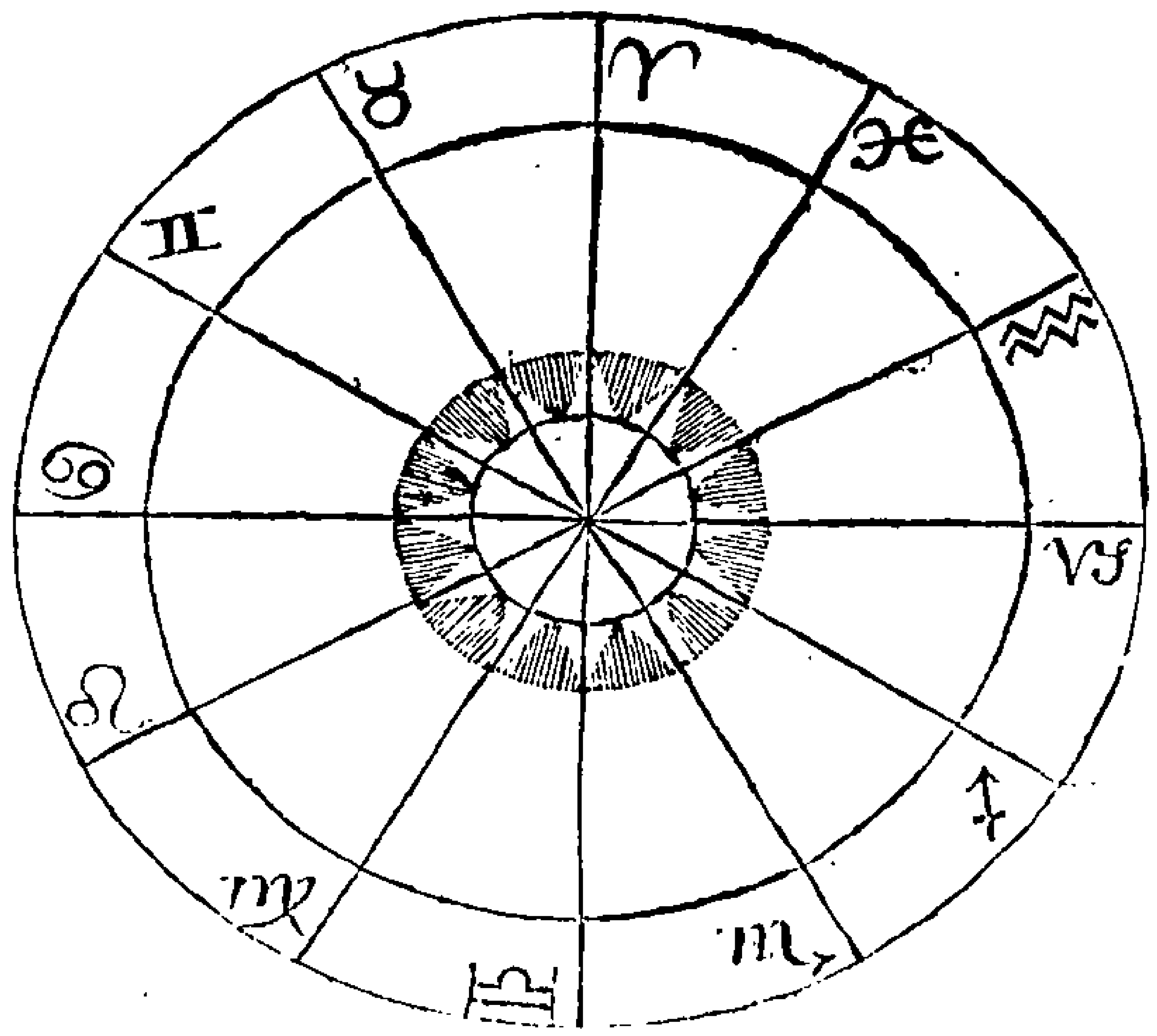
Operation *of the* **Latitudes.**

	Moon's Lat.		♀ Lat.
1764 April 6	4° N. 52′		0° N. 19′
7	5 11		0 21
As 24ʰ to	0 19	As 24ʰ to	0 2 Difference
So 5ʰ 53ᵐ to	0 5	So 5ʰ 53ᵐ to	0 1 To add to 1ſt Lat.
☽'s Lat. at the Op. of ☽ and ♂	4° N. 57		0° N. 20 ♂ Lat. at the Op. of ☽ and ♂
	0 N. 20		
	4° N. 37′ Moon ſuperior to ♀.		

The following FIGURE is for diſcovering the Times of the OPPOSITIONS, or other ASPECTS, of the *Cœleſtial* BODIES, from their PLACES in the ECLIPTIC being given, for any Year, and all the *Month-Days.*

Signs		
☞ 2	Diſtance in the Eclip-	*Sextile.*
3	tic between two *Cœ-*	*Quartile.*
4	*leſtial* Bodies called	*Trine.*
6		*Oppoſition.*

Two Bodies being in the ſame Point of the Ecliptic is called Conjunction. *See the Figure below.*



Example III. *To find the Times of the* New, Full, *and* Quarter Moons *for any Month in any Year; the* Sun *and* Moon's *Places to each Month and Day in that Year being given?*

For the Conjunction, or New Moon.

	☉ Place.	☽ Place.	☉ before ☽.
1764 March 2	12° ♓ 27′ 40″	10° ♓ 0′	2° 27′ 40″
3	13 27 41	22 13	*De la Caille's* Ephemerides, *Paris.*
Diurnal Motions ☉ and ☽	1 0 1	12 13	
		1 0	
Dif. Diurnal Motion ☽ à ☉ . . .		11 13	

		Lo. Log.
Now, As * Dif. Diurnal Motion ☽ à ☉ .	11° 13′ co.	9.2717
To 24 Hours . . .		0.3979
So Diſt. ☉ before ☽ at Noon from Conjunction	2 28 fere	1.3860
To Time of their Conjunction 5ʰ 16ᵐ paſt Noon, March 12th, 1764, at *Paris* or 5ʰ 7ᵐ at *Greenwich*, required.		1.0556

* *When the Planets are retrograde take the Sum inſtead of Difference of Diurnal Motion.*

Emendations. P. 228, 1 Col. l. 5. read ♈ or ♎ for ♈ and ♎. P. 231, 2 Col. N. B. *Sub. 4th from Co. Declination or Diſt. from N. Pole, for 5th Arc, when the ∠ from the Meridian is leſs than* 90°; *but add the 4th Arc to Co. Declination or Diſt. from the N. Pole, for 5th Arc, when ∠ from the Meridian is greater than* 90°. P. 231. 1 Col. l. 17. for Diſtance r. *Place* of the Mid-Heaven.

N. B. Adding the 4th Arc to the Co-Declination, when of contrary Name to the Pole, and taking the Supplement of the Sum for a 5th Arc, is the ſame as ſubtracting the ſaid 4th from the Diſt. from the Pole, for a 5th Arc. See *Examp.* p. 231.

As

Astronomical QUESTIONS applied to PRACTICE.

DECIMALLY.

As 11° 13′ to 24^h so 2° 28′ to 5^h 16^m
= 11,216   = 2,466 by 6 } = 24
     14,796 by 4 }
11,216)59,184(5^h,27 = 5^h 16^m as before.
56080

31040
22432

86080
78512

Rem. 7568

For the First Quarter Moon ?

	☉ Place.	☽ Place.	☉ before 3ˢ à ☽.
1764 March 10	20° ♓ 27′ 0″	15° ♊ 47′	4° 40′
11	21 26 45	28 8	*Note*, ♓ and ♊ are distant 3ˢ by foregoing Figure.
Diurnal Motions ☉ & ☽	59 45	12 21	
		1 —	
		11 21	

		Lo.Log.
NOW, As Dif. Diurnal Motion ☽ à Sun .	11° 21′ co.	9.2768
To 24 Hours		0.3979
So Dist. Sun before ☽ at Noon, from 3ˢ, or First Quarter . . .	4 40	1.1091
To the Time past Noon in their Distance 3ˢ or 1st Quarter at *Paris*	9^h 52^m	0.7838
Or	9 43	at *Greenwich* req.

DECIMALLY.

As 11° 21′ to 24^h so 4° 40′ to 9^h 52 m
= 11,35   = 4,666 by 6 } = 24
     27,996 by 4 }
11,35)111,984(9^h, 86 = 9^h 52 nearly; as before.
10215

9834
9080

7540
6810

Rem. 730

☞ *The slower moving Body of the two, must be less than the Difference of the Diurnal Motions, before the faster moving Body, to find the Time of all the Aspects, required to be known, betwixt the two Bodies.*

For the Opposition, or full Moon.

	Sun's Place.	☽ Place.	Sun bef. Oppⁿ. ☽
1764 March 17	27° ♓ 24′ 41″	20° ♍ 21′	7° 3′ 41″
18	28 24 11	5 ♎ 16	*Note*, ♓ and ♍ are opposite by the Figure foregoing.
Diur. Motions Sun & ☽	59 30	14 55	
		1 0	
Difference Diurnal Motion ☽ à Sun		13 55	

		Lo.Log.
NOW, As Dif. Diurnal Motion ☽ à Sun .	13° 55′ co.	9.3654
To 24 Hours		0.3979
So Dist. Sun before ☽ at Noon from Opposition .	7 4	0.9289
To the Time past Noon of her Opposition at *Paris*,	12^h 11^m	0.6922
Or	12 2	at *Greenwich* req.

DECIMALLY.

As 13° 55′ to 24^h so 7° 4′ to 12^h 11^m
= 13,916   = 7°,066 by 6 } = 24
     42,396 by 4 }
13,916)169,584(12^h,18 = 12^h 11^m as before.
13916

30424
27832

25920
13916

120040
111328

Rem. 8712

N. B. *The Difference of Meridians, in Time, between* Greenwich *and* Paris *is* 9^m 20^s, *that the same* Phænomenon *happens sooner at* Greenwich *than at* Paris.

For the last Quarter Moon.

	Sun's Place.	☽ Place.	Sun before 9ˢ à ☽
1764 March 24	4° ♈ 20′ 44″	2° ♑ 28′	1° 52′ 44″
25	5 20 0	15 55	*Note*, ♈ and ♑ are 9ˢ Distance by Figure foregoing.
Diur. Motions Sun & ☽ .	59 16	13 27	
		— 59	
Difference Diurnal Motion ☽ à Sun		12 28	

		Lo.Log.
NOW, As Diff. Diurnal Motion ☽ à Sun .	12° 28′ co.	9.3176
To 24 Hours		0.3979
So Dist. Sun before ☽ at Noon from 9ˢ the last or third Quarter	1 53	1.5038
To the Time past Noon in their Dist. of 9ˢ, or last Quarter at *Paris*	3^h 37^m	1.1187
Or	3 28	at *Greenwich* req.

DECIMALLY.

As 12° 28′ to 24^h so 1° 53′ to 3^h 38^m
= 12,466   = 1,883 by 6 } = 24
     11,298 by 4 }
12,466)45,192(3^h,62 = 3^h 37^m.
37398

77940
74796

31440
24932

Rem. 6508

N. B. When a Planet is retrograde, the Sun, instead of the Difference of Diurnal Motion, must be taken for all the Aspects.

XLVI. QUESTION. *To find the Time of the Moon's, and also a Planet's Southing, Rising and Setting* (practically) *from Ephemerides, and preceding Tables.*

FIRST, *For the Moon's Southing, or Passage through the Meridian ?*

RULE. Subtract the Sun's Right Ascension in Time, from the Moon's Right Ascension in Time at Noon, on the Day preceding the Time when the ☽'s Southing is required, and the Remainder will be the Time preceding Noon, of the Moon's Distance from the Meridian, when the Sun, at Noon, is then upon it.

NOW, while the *Sun* (by the Earth's revolving Easterly on it's *Axis*) is apparently departing from the Meridian to the Westward, as

☞ *It must always be noted in finding the Parallactic* ∠, P. 232, by D. *Cowper's improved compendious Method*, 2 Col. whether the Meridian ∠ is greater or less than 90°.

Ecliptic Place.
Meridian ∠ according to Table { ♋, ♌, ♍, ♎, ♏, ♐, } *Forenoon* Observation. { Supplement ∠ } *Afternoon* Observation.
Supplem^t. of Tab. ∠ { ♑, ♒, ♓, ♈, ♉, ♊, } { Tabular ∠ }
The Meridian ∠ above and below the Ecliptic, and one Side and other of the Meridian, being Supplements of each other to 180 respectively.

many

Aſtronomical QUESTIONS practically anſwered.

many Hours as the Moon wanted of coming to the *Meridian*, ſhe is advancing towards it, and would arrive there, in the Manner of a *Star*, had the Moon no Eaſterly Motion, in the Time of the Sun's paſſing thoſe Hours to the Weſtward; deducting the contrary Motion or Advance of the Sun's Right Aſcenſion in that Time, to the Eaſtward (*ſhewn* p. 218) all the while meeting the Star, and accelerating it's Approach to the ſame Meridian.——But by the Moon having a more conſiderable Eaſterly Motion of Right Aſcenſion in 24 Hours, than the Sun's Eaſterly Motion of Right Aſcenſion in that Time, therefore the Moon's Approach or coming to the Meridian is thereby retarded or prolonged; by as much as the Increaſe of the Moon's Right Aſcenſion in Time Eaſterly, from Noon, exceeds that of the Sun's in Time the ſame Way, during her Approach, from Noon, to the Meridian. For while the Sun is going that Time to the Weſtward, he ſpends the *Difference* of Increaſe of the two Right Aſcenſions more than the Moon's firſt Diſtance in Time, from the Meridian, while the Moon exactly arrives there.——Hence we have this *univerſal* and *correct* RULE, for *determining* the Time of *Paſſage* of the MOON, and of all the PLANETS through the MERIDIAN.

As 24 Hours is to the Difference *in Time, of the Moon's Increaſe of Right Aſcenſion above the Sun's* (or Increaſe of the Sun's Right Aſcenſion above a Planet's) *in that Time*, ſo is *the Diſtance of the Moon's from the Sun's Right Aſcenſion* (or Planet's Right Aſcenſion from the Sun's Right Aſcenſion) *in Time, at the Noon preceding the Time of the Southing required, to the* proportional *Increaſe of the Moon's Right Aſcenſion above that of the Sun's, in Time*, (or Sun's Right Aſcenſion greater or leſs than a Planet's in Time) *to be* added *to the* Moon's *or Planet's Diſtance from the Meridian at Noon* (but *ſubtracted* from a Planet's Diſtance at Noon, if the Sun is the Body of ſwifter Motion) *for the true or accurate Time of* Southing *of the* MOON *or* PLANET *ſought*.

N. B. *When the Sun's Right Aſcenſion is greater than the Moon or Planet's Right Aſcenſion, 24 Hours muſt be added to the latter, that Subtraction may be made of the firſt. And when the Planet moves Retrograde, the* Sum *of the Diurnal Right Aſcenſions of the Sun or Planet, in Time, are to be taken inſtead of the* Difference, *in the foregoing Proportions.*

M. *De la Caille*'s Eph. *Paris*	☽ Long.	☽ Lat. S.	☽ Decl. S.
Ex. I. 1762, July 10 Noon	5° ♓ 1′	4° 33′	13° 55′
11 Noon	16 55	3 59	8 50
Difference in 24 Hours	11 54 Increaſe.	0 34 Decreaſe.	5 5 Decreaſe.

☽'s Right Aſcenſion without Lat. 5° ♓ 1′ by p. 27. . . $22^h\ 27^m\ 27^s$

Days	☉ R. A.
10	$7^h\ 18^m\ 14^s$ —
11 July.	7 22 19
Incr. in 24 Hours.	4 5

Equation for 4° 33′ S. Lat. (Table foll.) = 1° 42′ 40″ + . . . Time 6 50 +

☽'s R. A. 10 July, Noon . . 22 34 17 . . . 22 34 17 fr.

☽'s R. A. Diſt. from Sun's R. A. 1762 July 10, Noon	15	16	3
Equation of the ☽'s Southing fr. Noon as below.	+	25	15
	15	41	18

☽'s R. A. without Latitude to 16° ♓ 55′ by Table foll. $23^h\ 11^m\ 51^s$

Equation for 3° 59′ S. Lat. (Table foll.) = 1° 35′ + . . . Time 6 12 +

☽'s R. A. 11 July, Noon 1762, 23 18 3

☽'s Southing 10th July paſt Noon, accurately req. at *Paris*, or $15^h\ 32^m$ at *Greenwich*.

☽'s Diurnal R. Aſcenſion between 10 and 11 July $43^m\ 46^s$ Increaſe.
Sun's Diurnal Right Aſcenſion . . . . . 4 5 Increaſe.

Difference of Diurnal Right Aſcenſion . . . 39 41 Increaſe.

Now ſay, As 24^h : $39^m\ 41^s$ :: $15^h\ 16^m$: $25^m\ 15^s$ to be added to Difference ☽'s Right Aſcenſion and ☉'s Right Aſcenſion, as above, for the correct Time of ☽'s Southing required.

N. B. The ☽'s Right Aſcenſion in Time anſwering to the Longitude and Latitude of the Moon, are more readily found from computed Tables of Right Aſcenſion in Time, anſwering to Longitude and Latitude at Sight.

	Long.	Lat. S.		R. A. ☽
Againſt	5° ♓ 1′	4° 33′	Stand	$22^h\ 34^m$
	16 55	3 59		23 18

Diurnal R. A. ☽ 0 44
Diurnal R. A. Sun. 0 4

Dif. Diurnal R. A. . . . . 0 40 *nearly*,

Or the Moon's Right Aſcenſion in Degrees is found by a SINGLE PROPORTION from the DATA; thus,

		Logarithms.
As Coſine Declination (N. or S.)	♈ 3° 55′ co.	0.0129389
To Coſ. Longitude from next Equinoctial Point here preceding	♈ 24 59	9.9573346
So Coſ. Latitude from the Ecliptic	4 33	9.9986292
To Coſ. R. A. from the ſame Equin. Point, ♈ preceding	21 25 28	9.9689027

In Time = $1^h\ 25^m\ 42^s$ R. A. from
24 0 0 [♈ preceding.

☽'s Right Aſcenſion from ♈ . . . 22 34 18 following.
Correctly and nearly as above.

		Logarithms.
Again, As Coſ. Declination	8° 50′ 0″ co.	0.0051819
To Coſ. Long. from ♈ preceding	13 5 0	9.9885770
So Coſine Lat. from the Ecliptic	3 59 0	9.9989496
To Coſ. R. A. from ♈ preceding	10 28 10	9.9927091

In Time = $0^h\ 41^m\ 53^s$ R. A. from
24 0 0 [♈ preceding.

☽'s Right Aſcenſion from ♈ . . . 23 18 7 following.
Correctly, and nearly as above.

☞ *Thus the Moon's Southing is* directly *and* accurately *determined (from the Longitude and Lat. of the Moon given for two ſucceeding Days) by two eaſy Operations, beſides a ſmall concluding Proportion; without the Trouble of an eſtimate Southing, as taught by moſt Authors.*

LEADBETTER *in his Aſtronomy (p. 264. 265, 1 vol.) by an eſtimate Method, finds the eſtimate Southing from the Moon's Age, which then from the Places and Latitudes of the Moon for two ſucceſſive Days, finds the Moon's Place to the eſtimate Southing by Proportion, and thence the Right Aſcenſion of Moon thereto, then he finds the Sun's Place to that eſtimate Time, whoſe Difference in Time, he makes the* approximate *Time of Southing for the* [illegible] *or the Diſtance the Sun is paſt the Meridian in Time, when the Moon is upon it.* HE *then adds the daily Difference of the Moon from the Sun, in Time for the Moon's Southing on the ſucceſſive Day, which is nearly true but not accurate.*

BUT *if the Moon and Sun's Right Aſcenſion are daily given in* Ephemerides, *the Difference of thoſe Aſcenſions, or Moon's Right Aſcenſion — Sun's Right Aſcenſion will always be the Moon's preceding Diſtance in Time from the Meridian, when the Sun is upon it. And if you* add the proportional *Diſtance in Time, thereto, for the* Exceſs *of the Increaſe of the Moon's Right Aſcenſion above the Sun's Right Aſcenſion in that Time, you will* accurately *and* ſhortly *find the Moon's* Southing, *for any Day; by Help of the* Conoiſance des Tems, *or other* Ephemerides, *wherein the Moon and Sun's daily Right Aſcenſions are given. And, if you continually* add *the daily Increaſe of the Moon's Right Aſcenſion above the Sun's Right Aſcenſion in Time, to the Time of the former Day's Southing of the* Moon, *you will correctly* (and not nearly) *have the Time, later and* later, of the Moon's Southing, *on ſucceſſive Days throughout the Year. And the ſame* Rule *holds good for finding the Times of the Planets Southing, ſucceſſively, by* adding *or* ſubtracting *to and from the Times of the former Day's Southing, the* Diurnal *Difference of Right Aſcenſion of the two Bodies, according as the* Sun (apparently) *is the ſlower or ſwifter moving Body than that whoſe Time of Southing is ſought.*

Aſtronomical QUESTIONS practically anſwered.

Mr. Charles Brent (who has done Service to *Computation*) in his *Aſtronomy*, p. 333, finds the near Time of the *Moon's Southing*, by taking the ☽'s Right Aſcenſion from Tables, as if ſhe had no Latitude; and then to find a ſtill nearer Time, he makes *Equation* for her real *Latitude* according to the *Sign* the Moon's Place is then in.

As his Method is near and eaſy, we here give it as plain as poſſible with a ſmall Improvement.

In the foregoing Example.

	h	m	s
☽'s R. A. without Lat. to 5° ♓ 1′ 1672, July 10 at Noon . . . . =	22	27	27
Sun's R. A. the ſame Time, had from Tab. *p.* 217 .	7	18	24
Near Time of Moon's Southing 1762, July 10 at *Paris*	15	9	13
Rule Add to which near Southing 2m 2s for every Hour thereof being about the Dif. of Motion in Time of ☽ à Sun in an Hour at a Mean . .	0	30	48
Nearer Time ☽'s Southing on that Day, paſt Noon .	15	40	1

Equation *for Latitude* ☽ *according to Mr.* Brent.

Rule. As greateſt Lat. 5° is to 8m Dif. of Time, ſo preſent Lat. 4° 33′ S. to 7m 16s + . . .	+	7	16
☽'s Southing at *Paris* 1762, *July* 10 paſt, Noon .	15	47	17

Rule for Sign of Equation. [11 Morning $3^h\ 37^m\ 7^s$ reqd.

☽'s Place.	Equation	☽'s Place.	Equation
♑ ♒ ♓ ♈ ♉ ♊		♋ ♌ ♍ ♎ ♏ ♐	
Lat. S. . :	+	Lat. N. . .	+
Lat. N. . .	—	Lat. S. . .	—

N. B. The above *eaſy Method* varies in the *Inſtance* given but 7^m too much, from the true Time of the Moon's Southing; and therefore, if uſed with the *firſt* Equation only *(omitting the laſt)* will be worth Regard; coming frequently very near the Truth, at the ſame Time it is very ready for *Practice*.

The other *more eaſy, but leſs near, Method* of finding the near Time of the *Moon's Southing*, is by multiplying the Days of her Age by 8 Tenths, for the Hours and decimal Parts of an Hour of her Southing paſt Noon, which are turned into *Minutes*, mentally, by multiplying thoſe *Decimal Parts* by 6.

The Moon's Age, 1762, *July* 10 . . 19 Days.
,8

15,2 =

Near Time of ☽'s Southg on that Day paſt Noon $15^h\ 12^m$
Or, *July* $11^d\ 3^h\ 12^m$ Morn.

Thus, having ſhewn how to find the *Southing* of the Moon, and all the Planets, accurately, as well as nearly, it follows next,

To find the Moon's, *and alſo a Planet's Riſing and Setting accurately, as well as nearly, for any* Place, *whoſe* Latitude *is given.*

Example II. *To find the Time of the* Moon's Riſing *and* Setting *at* Greenwich *Obſervatory*, 1762, July 10, *the Time of the Moon's Southing at* Paris *Obſervatory, having before been determined* $15^h\ 41^m\ 18^s$, *on that* Day *paſt Noon?*

First, *To find the* Time *of* Southing *under a* different Meridian? Time *Greenwich* is Weſt of *Paris* $9^m\ 20^s$

As 24^h is to the Time of later Southing of the Moon on the following than on the former Day, in the ſame Place (or to the Difference in Time of R. A. of ☉ and ☽ in 24 Hours) *ſo is* the Difference in Time between the *firſt* Meridian, and any other Meridian lying *Eaſt* or *Weſt* therefrom, to the Time of *ſooner* or *later* Southing *there* (reſpectively) than at the *firſt Place*; reckoning by Time in the *ſecond Place*.

☽ Souths *Paris*, 1762, *La Caille's Ephem.* 10 *July* P.M. $15^h\ 41^m$
11 . . . 16 22

Diff. 41

As 24^h to 41^m ſo $9^m\ 20^s$ to 16^s Moon *ſouths* later at *Greenwich* in *Greenwich* Time, than at *Paris*, in *Paris* Time.

For, As 24^h to $24^h\ 41^m$ ☽'s later Southing at *Paris*, ſo $9^m\ 20^s$ *Greenwich* is Weſt of *Paris* in Time, to $9^m\ 36^s$ the Moon is going from *Paris* to *Greenwich* Meridian.

	h	m	s
1762, *July* 10 ☽ ſouths at *Paris* in *Paris* Time, P. M.	15	41	
Time ſpent by the ☽ going from *Paris* to *Greenwich* Meridian Weſtward of *Paris* . .		9	36
☽ ſouths at *Greenwich* in *Paris* Time . .	15	50	36 P.M.
Deduct $9^m\ 20^s$, Time ſooner at *Greenwich* than at *Paris*		9	20
1762 *July* 10, ☽ ſouths at *Greenwich*, in *Greenwich* Time	15	41	16 P. M. as before.

To reduce Ephemerides from one Meridian to Another. And Firſt from *Paris* to *Greenwich* Meridian.

Universally. *As* 24^h *is to* $9^m\ 20^s$ *ſo is the following Day's Difference of the Moon's Southing, of the Sun's Place, Sun's Declination, Sun's Right Aſcenſ. Moon's Place, Moon's Latitude and Declination, or daily Difference of Longitude, Latitude, Declination, and alſo daily Difference ſ Southing of the Planets, or Stars, to the* reſpective *proportional Difference to be added to, or ſubſtracted from, the firſt Day's Times, Places, &c. at Noon, according as the daily Difference increaſe or decreaſe, for the Times, Places, &c. at* Greenwich; *correſpondent to the Times, Places, &c. at* Paris, Eaſtward *of* Greenwich—*The ſame Manner of proportioning holds for any other Difference of Meridian, inſtead of* $9^m\ 20^s$ Weſtward *of* Paris—Observatory. *And if the Meridian is* Eaſtward, *inſtead of* Weſtward *of* Paris, *or of any other firſt Meridian, then in reducing* Paris *Places, Times of Southing, &c. to thoſe for any other fixed Meridian to correſpond with a Second Meridian (Eaſtward of* Greenwich, *or the firſt Meridian) you muſt* ſubtract *the Proportional Diff. when the daily Diff.* increaſes, *and* add *it when the daily Diff.* decreaſes, *to the firſt Quantities,* reſpectively, *for the Quantities ſought, correſponding with the Second Meridian.*

And, becauſe $\frac{9^m\ 20^s}{24 \text{ Hours}} =$,0065 nearly. Therefore, decimally, Any daily Difference in *Paris Ephemerides*, being multiplied by 65 and four Figures cut off to the Right Hand in the Product will give the proportional Difference to be added to or ſubtracted from the firſt Day's Quantity, for the Quantity correſponding with *Greenwich Meridian.*

☽'s daily Diff. Southing 1762 *July* 10 and 11, 41^m
65 × r.

205
246

,2665 = 16^s as before.
Add $15^h\ 41^m$ 0

	h	m	s
Time of Southing at *Greenwich.*	15	41	16
Correſpond. to Time of Southing at *Paris*	15	41	0

☞ *The Southing of Planets and of the Moon in all Places nearly at the ſame Time of the Day or Night in each Place, is owing to the Sun Southing in all Places at* 12 *at Noon, or the ſame Time exactly in each Place; from which* Luminary, (meaſuring the apparent Time in all Places) the Cœleſtial Bodies vary their Diſtances, but a ſmall Matter in R. A. in 24 Hours, or diurnal Circuit; the Moon varying her Diſtance in R. A. in that Time the moſt.

Hence, the Moon varies her Time of Southing at *Greenwich* and at *Antigua* in the *Weſt-Indies*, but the *Sixth* Part of her *diurnal* Difference later, at the latter than at the former Place. For, 4 Hours Diff. of Meridians is equal the one Sixth of 24 Hours, in which Time the diurnal Difference of Southing is performed. Which Variation of ☽'s Southing, to an Hour *Diurnal* Difference, will be but 10 Minutes of Time reckoned later at *Antigua* than at *Greenwich.*

Aſtronomical QUESTIONS practically anſwered.

Therefore, it follows, that in ſeeking the Moon's *near* Time of *Riſing* and *Setting*, in all Places, you may uſe the Time of her Southing in any Place to compute the *Riſing* and *Setting* by. And, if you would compute the *Riſing* and *Setting* of the Planets, in any Place, the Time of their Southing (and eſpecially of the *Stars*) may be taken, with ſtill greater *Nearneſs* to Truth, from *Ephemerides* to ſerve for the Time of Southing in any one Place. The Difference of the Swiftneſs of Planets, (*Mercury*'s different Southing in 24 Hours, or *diurnal* Circuit, being ſeldom above 22 Minutes) amount not to above 11 Minutes of Time Difference of Southing in half the Globe Diſtance between two Places; and ſometimes not to a Quarter of that Quantity.

But, whatever this *Difference* is, whether of the Moon, or any of the Planet's Southing, it is readily had from correctly computed *Ephemerides*; by which the *Southing* for any Place is correctly found, and thence the *Riſing* and *Setting* of the *Moon* and *Planets* are had for that Place, as follows.

	☽'s Pla.	Lat. S.	☽ ſouths.	☽ Dec. S. at Noon.	
1762 *Ju.* 10	5 ♓ 1	4 33	$15^h\ 41^m$	13° 55′	*Paris.*
11	16 55	3 59	16 22	8 50	
LaCaille's Eph.					
Differences	Incr. 11 54	Dc. 34	Incr. 41′	5° 5′ Decr.	

Reduced to *Greenwich*, *July* 10 . . 13° 53′ Noon.

July 10.	$15^h\ 41^m\ 16^s$ ☽ ſouths P.M	10° 34′ ☽ Decl. S. correſpondent	*Greenwich.*

For, as 24^h : 5° 5′ Decr. Decl. : : $15^h\ 41^m$ P. M. : 3° 19′ Decr. Declination.

By *Tab.* p. 202, 203, *Semiduration* Arc, correſpondent to 10° 34′ ☽ S. Decl. and Latitude *Greenwich* 51° 28′½ . . . . . } ∓ $5^h\ 9^m\ 0^s$

☽'s Southing . . 15 41 16

Near Time ☽'s Riſing 10 *July* . . 10 32 16

Setting . P. M. 20 50 16

☽'s Declinations to { *Riſing* / *Setting* } thoſe mean Times { 11° 39′ / 9 28 } by Proportion.

For, as 24^h : 5° 5′ Decr. Decl. : : $10^h\ 32^m$: 2° 14′—

13 53

11 39

20 50 : 4° 25—

13 53

9 28

By *Tab.* p. 202, 203, Semiduration Arc, correſpondent to 11° 39′ ☽ S. Decl. Latitude *Greenwich* . . . . } — $5^h\ 4^m\ 0^s$

☽'s Southing . 15 41 16

Time ☽'s Riſing at *Greenwich*, 10 *July* 1762, allowing for Refraction; but not Parallax . } 10 37 16 paſt Noon.

By *Tab.* p. 202, 203, Semiduration Arc, correſpondent to 9° 28′ ☽ S. Declination Lat. *Greenwich* . . . . . . } + $5^h\ 18^m\ 0^s$

☽'s Southing . 15 41 16

Time ☽'s Setting, 10 *July* 1762, allowing for Refraction; but not Parallax . } P. M. 20 59 16 or 11^d 8 59 16 Morning.

OTHERWISE, To find the true RISING of the PLANETS.

Subtract the Sun's R. A. from the oblique Aſcenſion of the Planet, for the Latitude of the Place, and the Remainder *being more than ſix Hours, deduct 6 Hours therefrom, for the Time of* Riſing. *But, being leſs than 6 Hours, add 6 Hours thereto, for the Time of* Riſing.

1762 *July* 10, oblique Aſcenſion, by Tables for Latitude, *London*, to ☽'s Pl. 5 ♓ 1, Lat. S. 4° 33′ at Noon . . . . . . } $23^h\ 47^m$

☉ R. A. Noon, ſame Day, *De la Caille*'s Ephem. . —7 18

16 29

—6 0

Near Time of ☽'s Riſing 1762, *July* 10 . . . . 10 29 *paſt Noon.*

Correſpondent to which near Time of Riſing,

☽'s Place 10° ♓ 13′ Latitude S. 4° 18′ oblique Aſcen. $23^h\ 54^m$

☉'s R. A. 7 20

16 34

—6 0

Moon's true Time of Riſing 1762 *July* 10, at *Greenwich*, Refraction here being not allowed for } 10 34 Paſt Noon, *nearly as before.*

OF THE MOON'S PARALLAX AND REFRACTION.

☞ THE Horizontal *Parallax* is not conſidered in the foregoing *Rules* for finding the Riſing and Setting of the Moon, and therefore thoſe *Rules* find the Times of the true, and not apparent, Riſing and Setting of the Moon. The foregoing *Tables* of *Semidiurnal Arcs* are computed by allowing for *Refraction* of the *Celeſtial* Bodies; and therefore they very well ſerve to find the apparent (not the true) Riſing and Setting of the Planets.

But, the Moon having great *horizontal Parallax* (and conſiderable Parallax in Altitude) that *Parallax* muſt always be conſidered, together with the *Refraction*, for determining the Times of the apparent Riſing and Setting of the Sun and Moon; and thence to find whether an *Eclipſe* or *Occultation* will be viſible, or not, in a given Place; which is one conſiderable Uſe of what is called *viſible Time.*

The viſible Altitudes of the Moon, or other cœleſtial Bodies, muſt be truly augmented by *Parallax*, and decreaſed by Refraction; becauſe thoſe Bodies are apparently depreſſed by Parallax, and raiſed by Refraction; which contrary Appearances, or Effects, muſt therefore be always truly allowed for, (as above) by a contrary Augmentation and Decreaſe of their apparent, for determining their true Altitudes; and thence the true Time correſpondent. *So*, likewiſe, on the contrary, the viſible or apparent Riſing and Setting of the Moon muſt be determined from her given real *Place*, *Parallax* and Refraction, on a given Day, by reducing her real Altitude given, to her apparent Riſing, by Means of her horizontal *Parallax* depreſſing, and Refraction raiſing, her Body, at the ſame Time.

OF VISIBLE AND TRUE TIME.

HENCE, when the Moon's *Parallax* in Altitude, and *Refraction* are equal or alike, there is no Difference between viſible and true Time, *viz.* between the Time correſpondent to the viſible Altitude of the *Sun*, *Moon* or *Star*, and the Time correſpondent to their real Altitudes, which Times differ, when the Parallax and Refraction of the *Sun*, *Moon*, or *Star*, vary from Equality. This *Diſtinction* between *viſible* and *true Time* therefore reſpects the *viſible* and *true* Places or Altitudes of the *Sun*, *Moon* or *Star*, in the Heavens; which true Time (only reſpecting the true Altᵉ, not the viſible Time reſpecting the viſible Altitude) is equatable to *Mean* or *equal Time.*

THEREFORE the *Refractions* of the cœleſtial Bodies muſt, for the foregoing Reaſons, be always taken into Conſideration, and the *Parallaxes* alſo, where they are conſiderable, for diſcovering the *true Time*; which otherwiſe, in the Reſult of Computation, will be the viſible Time; conſiderably different, in ſome Caſes, from that which is true. Which true Time, as it refers to the Sun's Motion, will be what is

otherwiſe

Aſtronomical QUESTIONS practically anſwered.

otherwiſe called the *apparent Time* by the Sun, to be reduced, (as aforeſaid) to *equal* or *Clock Time*, by the *Equation of Time Table*, p. 19.

The Time of the viſible Conjunction of the Sun and Moon, ſeen from the Earth's Surface, always differs from the Time of the true Conjunction, as would appear from the Earth's Center: Except the Conjunction happens in the Nonageſimal *Degree of the Ecliptic, when the true and viſible Time are the ſame.*

Hence *it follows, that if the true Conjunction be in the* Oriental *Quadrant of the Ecliptic, or between the* Nonageſimal *Degree and Eaſtern Horizon, the Moon's Place is then apparently advanced Eaſterly by her Parallax of Longitude, and the Time of the viſible Conjunction will then be before the Time of the true Conjunction. But, if the* true Conjunction *fall in* Occidental *Quadrant of the Ecliptic, or between the* Nonageſimal *Degree of the Ecliptic and Weſtern Horizon, the Moon's Place will then be apparently advanced Weſterly, by as much as the Moon's Parallax is in* Longitude; *and conſequently the Time of the viſible Conjunction will follow the Time of the true Conjunction. Which Diſtinctions of* viſible, true *and alſo* equal *Time, are of Importance to be known in the Computation of* Eclipſes, *as well as in other Parts of Aſtronomy.*

The foregoing Account *of the Diſtinctions of Time*, is an Anſwer to one of our Correſpondents and Subſcribers writing thus. "*In all the Methods of finding the Hour of the Night by the Stars, no mention is made whether the Equation of Time is to be taken into Conſideration or not, or whether the Time found is apparent or equal; ſome People being at a Loſs in this Affair.*"

N. B. As the fixed Stars have no ſenſible Parallax, *only* their *Refraction* is to be conſidered in finding the *Hour* of the Night, apparent ſolar Time, by their *apparent* Altitude.

To find the True Time *of the* Moon's *apparent Riſing and Setting on* July 10th 1762, *at* Greenwich?

First, for the Moon's apparent Rising.

1762 July 10	Without Regard to Parallax.	Moon's Decl. correſpondent	Hor. Par. correſpon.	
	Riſing $10^h\ 37^m$	$11^\circ S 39'$	$55'\ 40''$	*De le Caille's* Ephem.
	Setting 20 59	9 28	55 36	

Moon below the viſible Horizon at her apparent Riſing by her Horizontal Refraction.	$33'$	$0''$	−
Moon's Horizontal Parallax then	55	40	+
Moon's true Altitude above the true Horizon at her apparent Riſing	22	40	+

Now, there are given,

						Logarithms.
Moon's Zenith Diſt.	89°	$37'$	$0''$	Side op. ∠ required		
Comp. Pole's Height	38	31	30	Sides inclu.	L.S.co.	0.2056123
☽'s Diſt. fr. N. Pole	101	39	0	∠ requird fr. Merid.	L.S.co.	0.0090402
Sum	229	47	30			. . .
From . . . . Half	114	53	45			. . .
Take Comp. Pole's Height	1 rem. 76	22	15	. . . .	Log. S.	9.9875952
Take ☽'s D. from N. Pole.	2 rem. 13	14	45	. . . .	Log. S.	9.3600812
					Sum	19.5623289
	37	10	11	L. S. . . .	Half	9.7811644
Double	74	20	22	∠ Apparent Riſing fr. the Merid.		

Now, As 360° is to *the* Interval *of Time betwixt two next Paſſages of the* Moon, *or any* Planet, *through the ſame Meridian*, ſo is *the angular Diſtance of that Cœleſtial Body, from the ſame Meridian, either at apparent Riſing, Setting, or any Altitude*, to *its Diſtance in Time from the Meridian.—To be ſubtracted from, or added to the Time of it's Southing, according as it is advancing towards, or has paſſed the Meridian, for the true Time of Riſing, Setting, or at any given Altitude.*

		Moon Souths	
1762 July	10	$15^h\ 41^m$	
	11	16 22	*De la Caille's* Eph. at *Paris.*

Difference $24^h + 41^m$ Difference alſo at *Greenwich.*

Now, As 360° to $24^h\ 41^m$ ſo $74^\circ\ 20'\ 22''$ to $5^h\ 5^m\ 49^s$ —

1762 *July* 10, ☽ Souths accur^y. at *Greenwich*, P.M.	15	41	16
1762 *July* 10, Moon apparently riſes at *Greenwich* P. M. accurately	10	35	27

N. B. *The Difference of the Time of the Moon or a Planet's Southing in each 24 Hours, is only the Difference of Right Aſcenſions of the Sun, and of that Planet, in Time. The cœleſtial Body Southing ſooner or later each Day, according as it's Motion is ſlower or faſter than the Sun's Motion in Right Aſcenſion.*

Next, for the Moon's apparent Setting.

The Difference of Horizontal Parallax at Moon's Riſing and Setting being here but 4″ leſs at Setting; the ſame Parallax may be uſed at Setting as for Riſing, viz. $55'\ 40''$; *whence,* ☽*'s true Altitude at apparent Setting, is* $22'\ 40''$; *or* $23'$ *very nearly, as before.*

Given,

						Logarithms.
Moon's Zenith Diſt.	89°	$37'$	$0''$	Side op. ∠ required		
Comp. Pole's Height	38	31	30	Sides inc.	L.S.co.	0.2056123
☽'s Diſt. fr. N. Pole	99	28	0	∠ req^d.	L.S.co.	0.0059551
Sum .	227	36	30			. . .
From . . Half .	113	48	15			. . .
Take Comp. Pole's Height	1 rem. 75	16	45		Log. S.	9.9855052
Take ☽'s D. fr. No. Pole.	2 rem. 14	20	15	. . . .	Log. S.	9.3938087
					Sum	19.5908813
	38	38	9	L. S. . .	Half	9.7954406
Double	77	16	18	∠ at apparent Setting fr. Merid.		

Now, As 360° to $24^h\ 41^m$ ſo $77^\circ\ 16'\ 18''$ to $5^h\ 17^m\ 53^s$

1762 July 10, Moon Souths at *Greenwich* accurately . . . . P. M.	15	41	16
1762 July 10, Moon apparently ſets at *Greenwich* accurately P. M.	20	59	9 [required.

☞ *Finding the accurate Time of the* Moon's *apparent Riſing and Setting, and alſo the accurate Time of the Night,* (which is performed in the ſame Manner) *to her apparent Altitude, has not been ſhewn before by any Author that we have ſeen.*

Whenever you would determine the Time by the *Moon's* or a *Planet's* Altitude, in any Latitude, to a Degree of *Accuracy*, the *Declination* of the cœleſtial Body at that Time, muſt be firſt determined *as near as poſſible*, by an *Eſtimate* of the Time; allowing for *Refraction*, and alſo *Parallax*; or the Time will differ conſiderably from the Truth; and anſwer no End in determining the *Longitude* from that Obſervation. For which Purpoſe, to facilitate the Operation, correct Ephemerides of the Sun and Moon's *Places, Declinations, Right Aſcenſions,* &c. with *their Differences*, for each Day of the Year, ſhould be carried to Sea, *if Promoters of Literature and Science in this Nation can be found*, to encourage the correct Computation of ſuch *uſeful Ephemerides*, as are encouraged in other Nations, for public Utility. Or, if our Astronomical Professors, who have made a *Secret of their Art*, can (like thoſe in other Nations) be prevailed upon to undertake the public Work.

If you would know the Time when the Moon's lower Limb *aſcends the viſible Horizon, you muſt add the* ☽*'s horizontal Semidiameter to her true Altitude, at apparent Riſing, and proceed as before, for her Center.*

Aftronomical QUESTIONS practically anfwered.

Or, if you would know the Time when the Moon's upper Limb *defcends the vifible Horizon, you muft fubtract her horizontal Semidiameter from the true Altitude at apparent Setting, (the fame as at Rifing) then proceed as in the foregoing Operation.*

One near *Method* to find the Time of *true* Rifing of the *Moon, Planet,* or *Star,* for a given Latitude, is by taking the Sun's *oblique* Afcenfion in Time, (for that Latitude) at the eftimate Time of the Moon's Planet or Star's Rifing, from their refpective *oblique* Afcenfion, in Time, at Rifing; *adding* the Time of *Sun-Rife* to the Remainder for the near Time of their refpective *Rifing* that Day.

This *Method* is rendered correcter by repeating the Operation to the *near Time* found; and alfo by finding the Moon, Planet, or Star's *oblique Afcenfion* to the Place and Latitude at that Time.

And the *near Time* to the Moon, a Planet, or Star's true Setting, is alfo found by taking the oblique Defcenfion of the Sun from their refpective oblique Defcenfion, at the *eftimate* Time of Setting; *adding* the Time of Sun-fetting, on that Day, to the Remainder, for the Time of the refpective Setting.

And, if you would be *more correct,* repeat the Operation to the laft found Time: Obferving to take the oblique Defcenfion of the *Moon, Star,* or *Planet,* correfpondent to its Latitude at the mean Time of Setting.

Another *near Method* of performing the fame is as follows.

From the oblique Defcenfion in Time of the *Moon, Planet,* or *Star, fubtract* the Right Afcenfion of the Sun, in Time, at the eftimate Time of Setting; and, if the *Remainder exceeds* 6 Hours, *fubtract* 6 Hours therefrom; but if the Remainder be *lefs* than 6 Hours, add 6 Hours thereto; the *Difference,* or *Sum,* refpectively, will be the Time of the *Moon, Planet,* or *Star's Setting,* required.

N. B. *The oblique* Defcenfions *are taken out of Tables of oblique* Afcenfions, *by entering them with the oppofite Sign and Degree of the Planet's Places, and contrary Name of Latitude to thofe Places. Alfo contrary Sign and Degree of the Sun's Place, without Latitude.*

EXAMPLE of the REDUCTION of PLACES from one MERIDIAN to ANOTHER.

	Sun's Pl. Noon.	☽'s Pl. Noon.	Decl. ☽.	Moon's Southing.	
1762 *July* 10	18° ♋ 3′	5° ♓ 1′	13° S 55′	15^h 41^m	*Paris* Obfervatory.
11	19 0	16 55	8 50	16 22	
Diurnal Diff.	+ 57	+ 11 54	− 5 5	+ 41^m	
Dif^s. by ,0065	Prop^l. Pt. + 22″	Prop^l. Pt. + 4′ 38″	Prop^l. Pt. − 1′ 59″	Prop^l. Pt. + 16″	

Reduced to *Greenwich* by neareft Minutes.

1762 *July* 10	18° ♋ 3′	5° ♓ 6′	13° 53′	15^h 41^m	*Greenwich.*
11	19 0	17 0	8 48	16 22	

Diurnal *Differences* as for *Paris* above.

N. B. The foregoing is a *Specimen* of the Reduction of Places from any Meridian to any other *Meridian* Weftward of the firft Place, according to Proportion of daily Difference, or Increafe or Decreafe of thofe Places from any Day to the next Day forward, for 360° Weftward. And therefore, the Proportion of Difference for *eafterly Longitude* from the firft Meridian, muft be *regulated* according to the Increafe or Decreafe from any Day to a former Day, for 360° Longitude *Eaftward:* The Difference for eafterly Longitude being contrary to that for wefterly Longitude: Increafe for Decreafe, and Decreafe for Increafe.

And the Sun, Moon, or a Planet's Declination, or right Afcenfion, for any *Place,* to the *Weftward* or *Eaftward* of *Greenwich,* is determined in the fame Manner, by proportioning for the *Difference* of Meridians Weftward or Eaftward, according to the Difference of the Declination, or right Afcenfion, *(or any other Requifite)* for a Day following or preceding, anfwering to a *diurnal* Circuit of the revolving Body.

EXAMPLE II. REDUCTION from PARIS to ANTIGUA-MERIDIAN: 4^h 9^m 20^s Weftward of *Paris-Obfervatory.*

	☉'s R.A. Noon. h m s	Sun's Dec. N. ° ′ ″	☽'s Decl. S. Noon. ° ′	
1762 *July* 10	7 18 14	22 15 13	13 S 55	*Paris. De la Caille.*
11	7 22 19	22 7 24	8 50	
Diurnal Diff^s.	+ 4 5	− 7 49	− 5 5	
As 24^h to 4^h 9^m 20^s, fo the refpective Dif^s to	Prop^l. Pt. + 42^s	Prop^l. Pt. − 1′ 21″	Prop^l. Pt. − 52′ 47″	*Antigua.*

,1731 X^r.

Reduced to *Antigua.*

	h m s	° ′ ″	° ′ ″	
1762 *July* 10	7 18 56	22 13 52	13 2 13	S.
11	7 23 1	22 6 3	7 57 13	S.

Diurnal Differences come out, as before, for *Paris Obfervatory.*

EXAMPLE. *To find the near Time of the Moon's true Setting, from the foregoing* RULES.

	☽'s Lat. Noon.	
1762 *July* 10	4° 33′	*Greenwich.*
11	3 59	
	34	

Correfpondent.

	Eftimate Time.	Sun's Pl.	☽'s Pl.	☽'s Lat.
1762 *July* 10	Setting 21^h 0^m	18° ♋ 52′	15° ♓ 31′	4° S 4′

Oppofite Places.

18° ♑ 52′	15° ♍ 31′	4° N 4′

Oppofite Places.	From *Tables* for 51° 32′ Lat. *London.*	h m
☽ 15° ♍ 31′ Lat 4° N. 4′	*Oblique Defcenfion.*	10 25
☉ 18° ♑ 52′	*Oblique Defcenfion.*	− 21 26

N. B. *The fame Method, with oblique Afcenfion, ferves to find the Moon's true Rifing.* See p. 240.

Rem. h. 12 59
Sun fets 10th *July* 8 8

Near Time ☽'s Setting 1762, *July* 10, paft Noon, 21 7
Correct Time of the Moon's apparent Setting . . h. 20 59

Difference . . h. 0 8

EXAMPLE II.

		h m
☽ 15° ♍ 31′ Lat. 4° N. 4′	Oblique Defcenfion.	10 25
☉ 18° ♑ 52′	R. A.	19 22

N. B. *When above* 12^h *remain,* 12^h *muft be added to the Refult* . . 15 3
− 6 0

Near Time of the Moon's true Setting 1762, on the 11th Day of *July* in the Forenoon, as *before,* 9 3
+ 12 0

Viz. 10th *July,* paft Noon . . 21 3

☞ *The fame Methods ferve to find the near Time of the* true *Rifing and Setting (not the apparent) of all the Planets; and when you would find the true Time of the true Rifing and Setting of the Moon, or any of the Planets, by either Method, you muft* repeat *the* Operation *to the laft found* near Time: Determining the Sun's Place, and Planet's Places, and Latitude to that Time, and the oblique and right Afcenfions from

thence. By which Means a *correct* or true Time will reſult after the *New Operation*.

The *eſtimate* Time of the Moon's Rising and Setting, or for any of the Planets, may be always had by reſpectively taking the right Aſcenſion of the *Sun* from the oblique Aſcenſion and Deſcenſion in Time, of the *Moon*, or *Planet*, (by Tables for the given Latitude of the Place) and *adding* or *ſubtracting* 6 Hours according as the Remainder be leſs or more than 6 Hours.

But, *univerſally*, the *eſtimate* Time of Riſing and Setting of the Moon, or any of the Planets or Stars, is readily determined by ſubtracting and adding the ſemidiurnal Arc, in Time, correſpondent to the Latitude of the Place, and the Moon or Planet's Declination at Noon, *(but better at Southing)* from and to the Time of Southing of the Moon or Planet for that Day, (of 24 Hours) on which the *Riſing* or *Setting* are required.

See Tables from p. 200 to 203, for this Purpoſe.

Mr. CHARLES BRENT, *(in his compendious Aſtronomer, p.* 334.) gives us *his Method* of finding the near Time of the Moon's true *Riſing* and *Setting*; after his finding her Southing, as before exhibited, which Method (with our ſmall Improvement) is as follows.

FIRST for the MOON's near DECLINATION to her true *Time* of SOUTHING.

THIS is found as the *Sun*'s Declination, from the *Declination Table,* (p. 23.) anſwerable to the Moon's Place in the Ecliptic, conſidered without Latitude, firſt ſubtracting from and adding to her Place at Southing, $\frac{1}{2}$ a Degree, for every Hour before and after her Southing.

Next, for every Degree of the Moon's Latitude to allow 5′ through all the Signs of the ☽'s Place, in the Ecliptic, according to this RULE.

Multiply the Degrees of *preſent* Latitude by 5′, And ſay, as 90° arc to that Product, ſo are the Number of Degrees of the Moon's Place, from *Cancer*, (betwixt *Aries* and *Libra)* or Number of Degrees from *Capricorn*, (betwixt *Libra* and *Aries)* to a *proportional Quantity*, to be always *ſubtracted* from the Moon's Latitude, for the *Quantity* to be *added* to or *ſubtracted* from her Declination, found according to her Place in the Ecliptic, without Latitude, for the Moon's near Declination at Southing, *required?*

Whether this laſt found Quantity *is to be added to, or ſubtracted from, the Ecliptic-Declination, you have this* RULE.

Lat. ☽.	*ſame*	Name	with Ecliptic Declination.	+	Quantity found.
	different			—	For Moon's Declination.

BUT, When the Latitude is *greater* than the Ecliptic-Declination, *that* muſt be deducted from the Latitude, for the Moon's *Declination, required*; which will then be of the *ſame Name* with the Moon's *Latitude.*

See Tab. following, for the ſame Purpoſe.

☞ From *New* to *Full* Moon, it is called the Moon's *Setting.*
From *Full* to *New* 'tis called the Moon's *Riſing.*

The Hours of Moon-Light being this Way determined.

You will always know, by the *Sun* and *Moon*'s Places, approaching to, or having paſſed, a *Conjunction,* or *Oppoſition,* whether it is the *Riſing* or *Setting* to be found.

For the Moon moving *ſwifter* than the Sun, if you ſubtract his from her Place, in the Ecliptic, the Diſtance, in *Signs,* will ſhew you their *Aſpect,* paſt, or to which they are approaching, according to the *following* Order of Signs, increaſing their Diſtance from New to Full; but diminiſhing their Diſtance, according to preceding Order of Signs, from *Full* to *New* Moon. *See* FIGURE *for the Aſpects, p.* 236.

RULE. With the *Moon*'s Declination, at Southing, juſt found, enter the Table of Semi-duration Arcs to a given Latitude, (ſee p. 200 to 203.) and take out the Time of that Arc, which ſubtract from and add to the true Southing, for the *eſtimate* Times of *Riſing* and *Setting*; to which eſtimate Times of Riſing and Setting find the Moon's reſpective Declinations, with which Declinations take out the ſemi-diurnal Arcs for Riſing and Setting. To each of which Arcs add as many Times $2^m\ 2^s$, (about the mean Motion in Time of Moon à Sun per Hour) as there are Hours, and ſubtract and add the Sum thereof reſpectively, from and to the Time of Southing, and you will have the *near* and reſpective Time of the *Moon*'s *Riſing* and *Setting,* required.

N. B. The Time of the ſemi-duration Arc for the Moon's *Riſing-Declination,* with $2^m\ 2^s$ for every Hour thereof, added, and Time of the Moon's Semi-duration Arc for her *Setting Declination,* with $2^m\ 2^s$ for every Hour thereof *added,* will be the Moon's Time of *Continuance* above the Horizon.

When the Moon's Setting Declination is nearly equal to and of the ſame Name with the Sun's Setting Declination, the ſemidiurnal Arc of the Sun, (the Time of Sun-Setting) *and ſemiduration Arc of the Moon, being then nearly equal, and to which the Time of Southing and ſemiduration Equation to the Moon's Setting Declination, are to be added, for the Moon's Time of* Setting, *therefore, in that Caſe* (and no other) *the Sum of the Time of* Southing *and of the Semi Duration* Equation, *will be the Hours of Moonlight after Sun-Setting, from* New *to* Full *Moon.*

In other Caſes, *between* New *and* Full *Moon, you muſt ſubtract the Time of Sun-Setting from the Time of Moon-Setting, and the Remainder will be the Hours of* Moon-Light *after Sun-Setting. So likewiſe between* Full *and* New *Moon, if you take the Time of Moon-Riſing from Sun-Riſing, you will have the Hours of Moon-Light, before Sun-Riſing.*

EXAMPLE *to the laſt near Method.*

	Sun's Place.	Moon's Place.	Moon's Lat. S.	Moon Souths.	
1762 *July* 10	18°♋3′	5°♓6′	4°S33′	15^h41^m	*Green-*
Noon . . 11	19 0	17 0	3 59	16 22	*wich*
Diurnal Diff^s.	+ 57	+11 54	— 34	+ 41	*Obſervatory.*

To find the Moon's Declination at Noon, correſpondent?

	July	Moon's Place.	Ecl. Declin. S.	☽ near Decl. S. correſpondent.	
Hence, by *Tab.* Page 23, and *Rule* foregoing.	10	5°♓6′	9° 39′ 19″	13° 55′ 43″	
	11	17 0	5 8 28	8 50 22	*Noon.*
		Diurnal Dif. . .		5 5 21	

FOR,

As 90° to 22′,7 (=4° 33′ × 5′) ſo 65° fr. ♑ to . . . . } — 16′ 36″ Equation.
4°33 ☽'s Lat. S.

☽'s Lat. and Ecliptic Decl. of ſame Name + 4 16 24 } equa^d Quan.
Ecliptic Declination 9 39 19 } S.

Sum . . Moon's *near* Declination, *July* 10, Noon . . . . } 13°55′43″ S.

AND,

As 90° to 20′ (= 4° × 5′) ſo 77° fr. ♑ to — 17′ 6″ Equation.
3 59 0 ☽'s Lat. S.

☽'s Lat. and Ecliptic Decl. ſame Name + 3 41 54 } Equ^d Quant.
Ecliptic Declination 5 8 28 } S.

Sum . . Moon's *near* Declination, *July* 11, Noon . . . . } 8 50 22 S.

As 24^h to 5° 5′ diurnal Decr. ☽'s Decl. ſo 15h 41m to 3° 19′
16 22 to 3 28

Astronomical QUESTIONS practically answered.

	☽ Decl. at Southing.	Mean sem. D. Arc.		
Hence *July* 10	10° 37′	5h 9m ∓		
Moon souths	15 41		Declinat. corresp. S.	Sem. D. Arc.
Estimate Rising *July* 10	10h 32m		11° 42′	5h 3m
Estimate Setting	20 50		8 35	5 19
Being near the true.	Past Noon.			

For, As 24^h to $5^\circ\ 5'$ diur. Decr. ☽'s Decl. so 10 32 to 2 14 (h m ° ′)
20 50 to 4 25

As 1^h to $2^m\ 2^s$ at a Mean, so 5 3 to 10 ; 5 19 to 11 (h m m) } Corrn S. Duratn. Arcs at a Mean.

h m		h m
Sem. D. Arc Rising 5 3		Sem. D. Arc Setting 5 19
Correction + 10		Correction + 11 at a Mean.
Corrected Sem. D. Arc 5 13		Cord. S. D. Arc 5 30
☽ Souths 15 41		☽ Souths 15 41
Near Time ☽'s true Rising . . . . . } 10 28		Setting 21 11 past Noon.

But, 24^h to 41^m true Incr. so 5 3 to 8 36 ; 5 19 to 9 4 (h m m s) } true Correcn to S. Duration Arcs.

h m	h m
Hence, 5 3	5 19
+ 9	9 true Corrn.
True S. D. Arc Rising 5 12	Tr. S. D. Arc Set. 5 28
☽ Souths 15 41	☽ Souths 15 41
Correct Time Moon's true Rising . . . . } 10 29	Correct T. ☽'s true Setting . . } 21 9

☞ *From the foregoing repeated Operations, the Moon's semi-duration Arc is seen to vary considerably by a* Change *of her Declination; making the semi-duration Arc longer or shorter, and consequently her Rising or Setting sooner or later, according as her South Declination, at Rising and Setting, happens to be less and more, and more and less, than at Southing; or her North Declination at Rising and Setting, more and less, or less and more, than her Declination at Southing.*

And as there is no *direct Way* of coming at the Moon's Declination at Rising and Setting, but by repeated Trials and Operations, (however accurate the semi-duration Arc may be found from a *given*, or *supposed* Declination of the Moon, at Rising or Setting, by *Trigonometry*, (or *Tables* for that Purpose) this last near METHOD, by a mean Declination at Southing, will discover the near Rising and Setting of the Moon *for all Latitudes*, the best and soonest of any Method whatsoever: neglecting the Correction of the Rising and Setting *semi-duration Arcs*, which is often compensated for in the mean Declination, taken at the Moon's Southing.

Hence, from what is done above,

	☽'s Declin. at Southing.	Mean S. Dur. Arc.
1762 *July* 11	5° 22′	5h 37m ∓
Moon souths	16 22 *La Caille's* Eph.	

Rises 10 45 } *nearly.*
Sets 21 59 }

Since the Moon's true semi-duration Arcs (from Rising to Southing and from Southing to Setting) depend on the *accurate* Determination of the Moon's Declination, at *Rising*, *Southing*, and *Setting*, (doubtfully obtained within few Minutes of Truth, because of the Declination's very variable Motion) there is not a more *difficult Question*, in practical Astronomy, to rightly resolve, than the foregoing, *Of finding the correct Time of the Moon's true or apparent Rising and Setting?*

And therefore we have been the more *particular* and *full* in explaining this useful *Question* on that Account. For the true Declination at *apparent* Rising and Setting must be previously had, as well as at the *true* Rising and Setting, before the angular Distance from the Meridian, respecting the *apparent* and *real* semi-duration Arcs, can be rightly found. And hence to determine in any Year, *On what Day of the Month in that Year, in a given Latitude, the greatest Difference between the Moon's* Rising *and* Southing, *and* Southing *and* Setting, *will happen, or when the Rising and Setting semi-duration Arcs will be most* unequal, *(or most* equal *if you please) would be a still more difficult Question, unknown in* practical *Astronomy: And was never yet resolved by the famous Author of the* Miscellaneous Tracts *and* Physical Astronomy.

XLVII. QUESTION. *To find the Point of the Ascendent, or Degree of the Ecliptic, ascending the Eastern Horizon, from the Latitude of the Place and Time of the Day, or Night,* (past the Meridian) *being given?*

EXAMPLE. In the Year 1764, *October* 14, at 10 at Night, what Point of the Ecliptic, at *London*, will be then rising, or ascending the Eastern *Horizon*?

Sun's Place at that Time, *London*	♎ 22° 1′ 19″
Sun's R. Ascension then, correspondent	200 21 26
Time from Noon 10 Hours in Degrees, *add*	150 0 0
Sum, R. Ascension of Mid-Heaven	350 21 26
Add	90 0 0
Sum (rejecting 360°) the oblique Ascension of the Ascendent	80 21 26 past *Aries.*

NOW, by PROPORTION.

		Logarithms.
As Radius	S. 90° 0′ 0″	10.0000000
To Cos. Obl. Ascension ascendent fr. ♈ or ♎ (here ♈)	80 21 26	9.2240274
So Cotan. Lat. Place	51 32 0	9.9000865
To Cotan. of 4th Arc	82 25 10	9.1241139
Here oblique Ascension ascendent is nearest ♈ *following*	+23 28 30	
5th Arc . .	105 53 40, or 74° 6′ 20″.	

N. B. *Here the 5th Arc exceeds* 90°.

Oblique Ascension of Ascendt.	*nearer* to ♈ than ♎ following or preceding.	*Sum* of the Ecliptic Obliquity and 4th Arc.	For a 5th *Arc.*
Oblique Ascension of Ascendt.	*nearer* to ♎ than ♈ following or preceding.	*Difference* of Ecliptic Obliquity and 4th Arc.	For a 5th *Arc.*

The *Projection shews the Truth.* This Answer is the Solution to the 7th Case of oblique spherical *Triangles*, where 2 Angles and an included Side are given to find the Side opposite to one of them.

Viz. Given	∠ = Co. Latitude ; ∠ Obliquity Ecliptic	included oblique Ascension from ♈ or ♎.	to find Dist. Ecliptic from same Equ. Point.
Or Given	∠ = Lat. + 90° ; ∠ Obliquity Eclipt.	included oblique Ascension from ♈ or ♎.	to find Dist. Ecliptic from same Equ. Point.

NOW,

Aſtronomical QUESTIONS practically anſwered.

		Logarithms.
NOW, As Coſ. 5th Arc	74° 6′ 20″ co.	0.5624619
To Coſ. 4th Arc	82 25 10	9.1203106
So Tan. Obl. Aſcen. Aſcend.	80 21 26	10.7697163
Here 5th Arc exceeds 90°. { To Tan. of the Diſtance of the Aſcendant from the *ſame* or *contrary* equ. Point from which the oblique Aſcenſion is reckoned . . }	70 34 4 from ♎ *preceding*, or ♋ 19° 25′ 56″ *following*, the Place of Aſcendant, *required*.	10.4524888

☞ When the 5th Arc is *leſs* than 90°, then you reckon the Diſtance of the *Aſcendent* on the Ecliptic, from the *ſame* equinoctial Point that the oblique Aſcenſion of the Aſcendant is reckoned from; but if the 5th Arc is greater than 90°, you reckon the Diſtance of the Aſcendant from the contrary equinoctial Point, to that from whence the oblique Aſcenſion of the Aſcendant is reckoned. For when the 5th Arc is greater than 90°, the Diſtance of the Aſcendant from the ſame equinoctial Point from whence the oblique Aſcenſion of the Aſcendant is reckoned, will be alſo greater than 90°; and the *Sines, Tangents, &c.* of Arcs, and of their Supplements, being the ſame, therefore the Anſwer will be from the contrary equinoctial Point, to give the Diſtance from the *ſame* equinoctial Point greater than 90°.

Hence when the oblique Aſcenſion is from an equinoctial Point, *preceding*, the Anſwer will be from the contrary equinoctial Point, *following*.

By the foregoing *neceſſary Diſtinctions* the Place of the Aſcendant of the Ecliptic, or Sun's Place at Riſing, correſpondent to the oblique Aſcenſion or Deſcenſion, of a Riſing or Setting Star, is *truly determined*.

If the Point of the Aſcendant at the Horizon (or Arc of the Ecliptic between the Meridian and Horizon) were required when the Beginning of *Aries*, or *Libra*, culminates, or is on the Meridian above the Horizon, the foregoing Proportions, for determining generally the Point of the Aſcendant, from ♈ or ♎, fail, and the following Proportions, in theſe *two Inſtances*, take Place.

Example II. *To find the Place of the* Aſcendant, *at* London, *when the Beginning of* Aries *is on the Meridian above the Horizon?*

Libra is then on the *inferior* Part of the Meridian below the Horizon, at *London*, and conſequently are given the Part of the Meridian below the Horizon, 38° 28′, = Complement of Latitude, the ∠ of Ecliptic and Meridian 66° 31′ 30″, and ∠ of Meridian and Horizon 90°, to find the Arc of Ecliptic betwixt the Meridian and Horizon. — Hence, by ſolving a right angled ſpherical Triangle, of one Leg, and an adjacent Angle to find the *Hypothenuſe*, being the inferior Arc of the Ecliptic betwixt the Horizon and Meridian, we have this

PROPORTION.

As Coſine Meridian ∠	66° 31′ 30″	9.6002636
To Radius S. . .	90 0 0	10.0000000
So Tang. of Comp. Latitude . . .	38 28 0	9.9000865
To Tan. Ecliptic between the Horizon and ♎ preceding. . . . . . }	63 22 16	10.2998229
From ♈ to ♎ . .	180 0 0	
Place of Aſcendant . .	116 37 44 fr. ♈ following *viz*, ♋ 26 37 44, required.	

Example III. *To find the Place of the Aſcendant at* London, *when the Beginning of* Libra *is on the Meridian, above the Horizon?*

Aries is then on the inferior Part of the Meridian, below the Horizon, at *London*, and conſequently are given, the Part of the Meridian above the Horizon 38° 28′ = the Complement of Latitude, 66° 31′ 30″ the ∠ of the Ecliptic and Meridian; and 90° the ∠ of the Meridian and Horizon; to find the ſuperior Arc of the Ecliptic between the Meridian and Horizon?

By ſolving a right-angled ſpherical Triangle of one Leg and an adjacent ∠ given, to find the Hypothenuſe, being the ſuperior Arc of the Ecliptic betwixt the Meridian and Horizon, we have, as before, this

PROPORTION.

As Coſine Meridian Angle	66° 31′ 30″	9.6002636
To Radius : S. . . .	90 0 0	10.0000000
So Tangent of Comp. Lat.	38 28 0	9.9000865
To Tang. Ecliptic betw. the Meridian (from ♎) and Horizon; *following* }	63 22 16	10.2998229
	Place of Aſcendant following, [or ♐ 3° 22′ 16″, required.	

N. B. When ♋ or ♑ *culminates*, the Arc of the Ecliptic betwixt the Meridian and Eaſtern or Weſtern Horizon is evidently a Quadrant; the Meridian being then the *ſolſtitial Colure*. Therefore, when ♋ culminates, the Place of the Aſcendant will be the Beginning of ♎; and that of the Deſcendant the Beginning of ♈. And when ♑ culminates, the Place of the Aſcendant will be the Beginning of ♈, and that of the Deſcendant the Beginning of ♎: the Places of Aſcendant and Deſcendant being always oppoſite; and the Arcs of the Ecliptic between the Meridian and Eaſtern and Weſtern Horizon are the Supplements of each other to 180°.

The Places of the *Aſcendant*, at the Beginning of each Sign culminating, is nearly as follows, by the foregoing *Rules* and *Proportions*, or this Rule.

As S. ∠ of Ecliptic and Meridian to S. Altitude of Mid-Heaven, ſo Radius to S. Arc between Meridian and Horizon.

Mid-Heaven.	Place of Aſcendant.	Arc of Ecliptic betw. Merid. and Eaſt. Horiz.
Begin. ♈	♋ 26° 38′	116° 38′
♉	♌ 16 30	106 30
♊	♍ 7 21	97 21
♋	♎ 0 0	90 0
♌	♎ 22 38	82 38
♍	♏ 13 30	73 30
♎	♐ 3 22	63 22
♏	♐ 25 22	55 15
♐	♑ 27 10	57 10
♑	♈ 0 0	90 0
♒	♊ 2 50	122 50
♓	♋ 4 45	124 45

Hence, *it would be a proper* Queſtion *to determine the Place of the* Aſcendant, *and what Sign and Degree of the Ecliptic culminates, when the* greateſt *and* leaſt Diſtances *of the Ecliptic are included betwixt the Meridian and Horizon.*

N. B. The above eaſtern Arcs will be a Guide in determining others that are ambiguous.

☞ *The Place of the* Aſcendant *may be otherwiſe found, from the* ∠ *of the Ecliptic and Meridian, Mid-Heaven, Zenith Diſtance, correſpondent to right Aſcenſion of Mid-Heaven, and* 90° *from Zenith to the Aſcendant, given, in an oblique ſpherical Triangle, to find the Arc of Ecliptic betwixt the Meridian and Horizon?*

XLVIII. Question. *To find the Day of the Year in a given Latitude, when a Star, or Planet, will riſe with the Sun, (or riſes* coſmically) *from the oblique Aſcenſion of that Star or Planet being given?*

AS every Star, or Planet, riſes with the *Point of the Ecliptic*, having the ſame *oblique Aſcenſion* with that Star, or Planet, it follows, that when the Sun is in that Point of the Ecliptic, the ſame Star, or Planet, will riſe with the Sun, or *coſmically*.

Aſtronomical QUESTIONS practically anſwered.

Example. *Required the Day when the bright Star in the Eagle riſes with the Sun, at* London, 1760?

By P. 210, N°. 126.

		°	′	″
Corrected to 1760 Begin.	Declination N. bright Star in Eagle . . .	8	15	8
	Right Aſcenſion of that Star	294	46	3
Aſcenſional Dif. in Degs (by Queſt. VI.) ſubtract . .		10	31	6
Oblique Aſcenſion ✱ from ♈, following		284	14	57
——— From ♈, preceding		75	45	3

NOW, by *the preceding Queſtion* XLVII.

				Logarithms.
As Radius . . . . S.	90°	0′	0″	10.0000000
To Coſ. obl. Aſcen. ✱ fr. next equin. Point (here ♈ preceding) . . .	75	45	3	9.3911808
So Cotang. Lat. Place, *London* . . .	51	32	0	9.9000865
To Cotang. of 4th Arc	78	56	7	9.2912673
Obliq. Aſcen. ☉ or ✱ neareſt ♈ preceding. add +	23	28	30	Eclip. Obliq.
NOW, As Coſ. . . 5th Arc . .	102	24	37	
Or . .	77	35	23 co.	0.6677423
To Coſ. . . . . . . 4th Arc . .	78	56	7	9.2831151
So Tang. obl. Aſcen. ✱ or ☉ . . .	75	45	3	10.5952481
To Tang. of Pl. of Aſcend. fr. ♎ follows	74	7	32	10.5461055

Or contrary eq. Pt. fr. whence obl. Aſcen. is reckoned; becauſe 5th Arc is more than 90°. } or ♐ 14° 7′ 32″ Sun's Place, required.

Which Place anſwers to the *6th of* December, 1760, N. S. *when the bright Star in the* Eagle *and the* Sun *riſe together; and will continue to riſe together nearly on that Day for a Number of Years, at* London, *or moſt Places near the Middle of* England.

XLIX. Question. *To determine the Day of the Year,* 1760, *at* London, *when the aforeſaid bright Star in the Eagle ſets at the Time the Sun riſes, (or ſets* coſmically) *from the oblique Deſcenſion of that Star, given?*

	°	′	″
Right Aſcenſion of the Star as before	294	46	3
Aſcenſional Dif. in Degrees as before, *add*	10	31	6
Sum, Oblique Deſcenſion ✱ fr. ♈ following, given . .	305	17	9
Add	180	0	0
Oblique Aſcenſion of the Aſcendant, then (rejecting 360°) from ♈ following	125	17	9
Supplement — obl. Aſcen. from ♎ preceding . . .	54	42	51

Now, proceed to find the Place of the Aſcendant at Sun-Riſing, when the Star ſets, from the oblique Aſcenſion of the Aſcendant given, as before.

As Radius . . . . S.	90°	0′	0″	10.0000000
To Coſ. obl. Aſc. fr. next eq. Pt. ♎ pre.	54	42	51	9.7616691
So Cotan. Lat. *London*	51	32	0	9.9000865
To Cotan. 4th Arc	65	20	52	9.6617556
Ob. *Aſcen.* of ☉ *neareſt* ♎ *preced.* ſub. —	23	28	30	
As Coſ. . . . . . 5th Arc : .	41	52	22 co.	0.1280602
To Coſ. . . . . . . 4th Arc . .	65	20	52	9.6202500
So Tan. obl. Aſcen. Aſcent fr. ♎ preced.	54	42	51	10.1501703
To Tan. of Pl. of the Aſcend. fr. ♎ preced.	38	21	49	9.8984805

Or ſame Equ. Point from whence obl. Aſcen. Aſcendt. is reckoned; becauſe the 5th Arc is leſs than 90°. } or 141° 38′ 11″ from ♈ followg. *viz.* ♌ 21° 38′ 11″ Sun's Place, required.

Which Place anſwers to the 14*th* Aug. 1760, *N. S. when the Sun riſes, as the bright Star in the Eagle ſets, at* London, *and will continue to riſe and ſet together nearly on that Day for a Number of Years, at* London, *or moſt Places near the Middle of* England.

L. Question. *To find the Day, in the Year* 1760, *at* London, *when the aforeſaid bright Star in the Eagle, will riſe, as the Sun ſets, (or riſe* achronically) *from the oblique Aſcenſion of that Star being given?*

THE Anſwer to this Queſtion is contained in the Anſwer to the former Queſtion, being only to find the Point of the *Deſcendant,* or *Setting*-Point of the Ecliptic, oppoſite to the *Riſing*-Point thereof, or Pl. of the *Aſcendant,* found to the *coſmical* Riſing of a Star with the Sun. Which Place of the *Deſcendant* will be the Sun's Place, at Setting, anſwerable to the *achronical* Riſing of that *Star.*

Thus, the Place of *Aſcendent* at *coſmical* Riſing of the bright Star in the Eagle is found } ♐ 14° 7′ 32″

Whence the oppoſite Place of *Sun-Setting,* at *achronical* Riſing of the ſame Star . . . } ♊ 14° 7′ 32″

Which Place is anſwerable to June *the* 4*th,* 1760, *N. S. when the bright Star in the Eagle riſes achronically, required.*

This Star will continue to riſe achronically, on that Day, at moſt Places near the Middle of England, *for a Number of Years.*

LI. Question. *To find the Day, in the Year* 1760, *at* London, *when the aforeſaid bright Star in the Eagle will ſet as the Sun ſets, (or ſet* achronically) *from the oblique Deſcenſion of that Star being given?*

THE Anſwer to this Queſtion is contained in the Anſwer to XLIX. Queſtion.

The ſame Point of the Ecliptic, or Place of Deſcendant, that ſets with the aforeſaid Star, is the Sun's Place, at Setting, when that Star ſets *(achronically)* as the Sun ſets. Therefore, the oppoſite Point of the Ecliptic, to that of the Aſcendant, when the ſame Star ſets *coſmically,* or at Sun-Riſing, will evidently be the Place of the *Deſcendant,* or Sun's Place in the Ecliptic, at his Setting when the Star ſets, *achronically.*

Thus, the Place of the Aſcendant, or of Sun-Riſing, at *coſmical* Setting of the *bright* Star in the *Eagle,* being found . . . . } ♌ 21° 38′ 11″

The *oppoſite* Place to Sun-Riſing, at *coſmical* Setting, is the Place of the Ecliptic at *achronical* Setting, of the ſame Star, *viz.* . . . . } ♒ 21° 38′ 11″

Which Place anſwers to February 9, 1760, *N. S. when the bright Star in the Eagle ſets* achronically, *required.*

This Star will continue to ſet achronically on that Day, in moſt Places near the Middle of England, *for a Number of Years.*

A

A TABLE of the DAYS in the YEAR, *New Style*, when the *cosmical* and *achronical* Rising and Setting of 42 eminent Fixed Stars happen at *London*.

N. B, *Cosmical* Rising and Setting of a *Star* is at Sun-*Rise*; *Achronical* Rising and Setting of a *Star* is at Sun-set.

No.	STARS NAMES.	*Cosmical.* Rising at *Sun* Rise.	*Cosmical.* Setting at *Sun* Rise.	*Achronical.* Rising at *Sun* Set.	*Achronical.* Setting at *Sun* Set.
	THE				
1	First in the Wing of *Pegasus*, *Marchab*	*January* 12	*September* 24	*July* 17	*March* 22
2	Right Shoulder of *Æquarius*	20	*August* 29	24	*February* 24
3	Extreme in the Wing of *Pegasus*	*February* 8	*October* 5	16	*April* 2
4	Last in the Tail of the *Goat*	18	*August* 11	24	*February* 7
5	Bright ✱ in the Head of *Aries*	*March* 15	*November* 4	*September* 18	*May* 2
6	In the preceding Horn of the *Ram*, or 1 ✱ ♈	21	*October* 30	23	*April* 27
7	In Whale's Tail	*April* 23	*September* 15	*October* 27	*March* 13
8	Brightest in the *Pleiades*	*May* 4	*November* 23	*November* 6	*May* 21
9	Brightest in the *Whale*'s Mouth, *Mencar*	31	*October* 26	30	*April* 23
10	Northern Horn of the *Bull*, or Foot of *Auriga*	26	*November* 21	26	*May* 20
11	*Fomahaunt*	21	*August* 4	21	*January* 31
12	Northern Eye of the *Bull*	31	*November* 24	*December* 2	*May* 23
13	Bright ✱ in the Belly of the *Whale*	*June* 3	*September* 23	5	*March* 21
14	Southern Eye of the *Bull*, *Aldebaran*	8	*November* 24	10	*May* 23
15	Southern Horn of the *Bull*	16	*December* 11	17	*June* 10
16	*Castor*	20	*February* 14	21	*August* 17
17	*Pollux*	*July* 3	*January* 30	*January* 1	3
18	Middle Star in *Orion*'s Belt	14	*November* 17	10	*May* 16
19	Little Dog, *Procyon*	30	*December* 18	25	*June* 17
20	Bright ✱ in the Hare's Thigh	*August* 2	*October* 29	29	*April* 26
21	Bright ✱ in the great Dog's Mouth, *Syrius*	11	*November* 16	*February* 6	*May* 14
22	*Lion*'s Heart	20	*February* 24	15	*August* 29
23	*Lion*'s Back	21	*April* 27	16	*October* 30
24	*Hydra*'s Heart	31	*December* 28	26	*June* 28
25	Bright ✱ in the *Lion*'s Tail, *Deneb*	*September* 2	*April* 26	29	*October* 29
26	*Vindematrix*	21	*May* 18	*March* 18	*November* 20
27	*Arcturus*	26	*June* 23	23	*December* 22
28	Bright ✱ in the *Virgin*'s Girdle	30	*April* 30	27	*November* 2
29	Bright ✱ in the *Crown*	*October* 9	*July* 20	28	*January* 17
30	Virgin's *Spike*	15	*April* 7	*April* 12	*October* 11
31	Right Shoulder of *Hercules*	17	*July* 23	14	*January* 20
32	Left Shoulder of *Hercules*	21	*August* 5	20	*February* 1
33	Head of *Hercules*	*November* 1	*July* 22	30	1[illegible]
34	*Swan*'s Bill	10	*September* 1	*May* 8	2[illegible]
35	Right Shoulder of *Ophiuchus*, *Serpentarius*	16	*July* 18	14	*January* 16
36	Inferior Wing of the *Swan*	16	*September* 26	15	*March* 16
37	Vulture's *Tail*	22	*August* 12	20	*February* 8
38	Right Knee of *Ophiuchus*, or of *Serpentarius*	27	*June* 18	21	*December* 18
39	*Scorpion*'s Heart	*December* 3	*May* 16	*June* 2	*November* 17
40	Bright ✱ in the Eagle	6	*August* 14	4	*February* 9
41	Bright ✱ in the Thigh of *Pegasus*, *Scheat*	22	*October* 7	22	*April* 3
42	Bright ✱ in the Head of *Andromeda*	*January* 5	22	*July* 7	*January* 5

EXPLANATION.

The Sun, in his annual *Motion* through the Ecliptic, gets to the Eastward of the *Fixed Stars*; therefore, *In North Latitudes of Places, Stars having South Declination*,

contrarily.

1st { From *Cosmical* Setting (at Sun Rise / To *Achronical* Rising (at Sun Set } Stars set before Sun Rise } rise after Sun-Set } are *visible*, above the *Horizon*, from their Rising to Setting during that *Interval*.

Example I. *Scorpion's Heart visible from its Rising to Setting from* May 16, *to* June 2, *following*.

contrarily.

2d *contrarily* { From *Achronical* Setting (at Sun Set / To *Cosmical* Rising (at Sun Rise } Stars set before Sun Set } rise after Sun Rise } are *invisible*, above the *Horizon*, from their Rising to Setting, during that *Interval*.

Example II. *Scorpion's Heart invisible from its Rising to Setting, in the Day from* November 17, *to* December 3, *following*.

contrarily.

3d { From *Cosmical* Rising (at Sun Rise, / To *Achronical* Setting (at Sun Set } Stars rise before Sun Rise } set after Sun Set } are constantly *visible*, above the *Horizon*, at some Time of the Night.

Example III. *Scorpion's Heart visible sometime between Rising and Setting, from* December 3, *to* November 17, *following*.

In North Latitudes of Places, Stars having North Declination.

contrarily.

4th { From *Achronical* Rising (at Sun Set / To *Cosmical* Rising (at Sun Rise } Stars rise before Sun Set } set after Sun Rise } are *visible* till they approach so near the *Sun*, as to be hid in hi[s] Rays.

Example IV. *The* Pleiades *visible from* November 6, *to* May 4, *following, or till they approach so near the Sun as to be hid in his Rays*; which when a Star recovers from, and is seen in the Morning, before Sun Rise, is called its *Heliacal* Rising; as the near Approach of a Star to the Sun, in the Evening, so as to become inconspicuous, is called, the *Heliacal* Setting of that Star—The Time to be determined as follows.

Astronomical QUESTIONS practically answered.

LII. QUESTION. *To find the Time of a Star's* heliacal *Rising, from the Latitude of the Place and Star's oblique Ascension, with the Sun's* Depression *below the Horizon, at the Time of that Star's* heliacal *Rising (after its cosmical Rising) being given?*

OBSERVATION shews that the *smallest Stars* are invisible while the upper Hemisphere receive any of the Sun's Rays; and therefore are first seen in the Evening, at the End of Evening Twilight, and last seen in the Morning, at the Beginning of Morning Twilight, when the Sun, at either of those Times, is 18° *below* the Horizon. And *Stars* of different Magnitudes are observed to appear first and last in the Evening and Morning, *respectively*, when the Sun's Depression, *below* the Horizon, is as follows.

			Deg.	
Stars of the	1	*Magnitude* appear *first and last* in the Evening and Morning, when the Sun is	12	*Below the Horizon.*
	2		13	
	3		14	
	4		15	
	5		16	
	6		17	

EXAMPLE. *The Month is required in the Year* 1760, *when the bright Star in the Eagle* (of the 2d Magnitude) *will rise* heliacally, *at* London?

N. B. It will rise *heliacally* when the Sun has described an Arch of the Ecliptic, further to the Eastward, from his Place at *cosmical* Rising, correspondent to 13° of his Depression below the Horizon, at the Time of the same Star's Rising. *Consequently heliacal is after cosmical Rising, and is when the same Star first begins to appear, after being hid under the Sun's Rays.*

	°	′	″
Oblique Ascension of the bright Star in the *Eagle*, before found	284	14	57
Subtract 90°	90	0	0
Remain R. A. of Mid-Heaven at the Star's Rising	194	14	57
R. A. from ♎ following	14	14	57
Longitude of Mid-Heaven, correspondent fr. ♎ following (by *Quest.* 34.)	15	28	32
Meridian ∠ correspondent *(by Tab. p.* 23, *or* 35 *Quest.)*	67	17	18
Declination of Mid-Heaven S. correspondent *(by Tab. p.* 23, *or* 36 *Quest.)*	6	6	6
Mid-Heaven Zenith Distance, *London*	57	38	6

Now there are given, in an oblique spherical Triangle, the Meridian ∠, Mid-Heaven Zenith Distance, as above, and the Sun's Zenith-Distance 103°, *at the Time of the Star's heliacal Rising, to find the Arch of the Ecliptic between the Meridian and the Sun, at that Time?*

Viz. Two Sides, (the Mid-Heaven Zenith Distance and Sun's Zenith Distance) with an Angle (the Meridian Angle) opposite to one of them given (the Sun's Zenith-Distance) to find the *third* Side, intercepted between the Meridian and Sun.

PROPORTION.				*Logarithms.*
As Radius	S. 90°			10.0000000
To Tan. Mid-Heaven Zen. Distance	57	38	6	10.1980733
So Cos. Meridian ∠	67	17	18	9.5866930
To Tang. 4th Arc	31	21	1	9.7847663

				Logarithms.
As Cos. Mid-Heaven Zenith Distance	57	38	6 co.	0.2713939
To Cos. Sun's Zenith Distance	77	0	0	9.3520880
Therefore, Supplement of the Answer must be taken	for 103	0	0	
So Cos. 4th Arc	31	21	1	9.9314592
To Cosine of	68	58	8	9.5549411
Its Supplement, 5th Arc	111	1	52	
Dif. between 4th and 5th Arcs	79	40	51	Ecliptic Arc, required.

☞ Because the Meridian Angle, next to which the Perpendicular falls, is above 90° fr. Place Mid-Heaven, or less than 90°,

When Mid-Heaven Longitude is in	♋, ♌, ♍, ♎, ♏, ♐,	*Dif.	4th and 5th Arcs for the Ecliptic Arc between the Merid. and Sun.
	♑, ♒, ♓, ♈, ♉, ♊,	Sum	

* For East of the Meridian, or Rising; but *Sum* and *Dif.* for West of it, or Setting.

When Supplement of an Arc above 90° is used (as 77° for 103°) the Supplement of the Answer (but not otherwise) must be taken, as 111° 1′ 52″ for 68° 58′ 8″, above.

OTHERWISE, to find the *Ecliptic Arc below the Horizon, the superior Arc being found, in the Longitude of the Ascendant at the Star's* cosmical *Rising.*

As Sine Sun's Zenith Distance	77°		co.	0.0112761
To S. Meridian Angle	67	17	18	9.9649473
So S. Mid-Heaven Zenith Distance	57	38	6	9.9266793
To Sine ∠ of the *Vertical* and Ecliptic, below the Horizon	53	5	50	9.9029027
Or *Parallactic* ∠, at the Ecliptic.				

NOW, As Radius	90°			10.0000000
To Cotan. Depression	13°	0′	0″	10.6360359
So Cos. Paral. ∠ below Horiz.	53	5	50	9.7784834
To Cotan. of an Arc of Eclip. below the Horizon, *correspondent*	21	1	52	10.4151193
Add ♐	14	7	32	Sun's Pl. at ✱'s cosmical Ris.
♑	5	9	24	Sun's Pl. at ✱'s heliacal Rising.

Or, As S. ∠ of the Horizon and Ecliptic,
To Sine of the Sun's Depression, at heliacal Rising or Setting of a Star, or Planet,
So is Radius,
To Sine of Ecliptic Arc below the Horizon, correspondent.

The foregoing Place of the Sun answers to the 26th of *December*, N. S. 1760, when the bright Star in the Eagle rises *heliacally*, required; the *Sun* being then 13° below the Horizon. Which Star will continue to rise *heliacally* on that Day, for a Number of Years, after having rose *cosmically*, at the same Time with the Sun, (and consequently invisible) on the 6th Day of the same Month. *So that on the* 26*th of* December *the bright Star in the Eagle* begins to appear, after being hid in the Sun's Rays, from and before *December* 6, at rising with the Sun. After the *heliacal* Rising *December* 26, it continues to appear in the Morning before Sun-Rise.

Aſtronomical QUESTIONS practically anſwered.

	°	′	″	
Longitude of the Aſcendant foregoing, at the Star's Riſing, p. 246.	254	7	32	fr. ♈ following.
Longitude of Mid-Heaven, then	195	28	32	fr. ♈ following.
Ecliptic Arc from Meridian to Horizon, at Star's Riſing	58	39	0	
Add Ecliptic Arc fr. Horizon to the Sun depreſſed laſt found	21	1	52	
Ecliptic Arc from the Meridian to the Sun, as firſt found	79	40	52	
Add Mid-Heaven Longitude	195	28	32	
	275	9	24	fr. ♈ following.
To ♑, 9 Signs, Subtract	270			
Remains Sun's Place at the Star's *heliacal* Riſing, as before.	♑ 5	9	24	

LIII. Question. *To find the Time of a Star's* heliacal *Setting, from the Latitude of the Place, and Star's oblique Deſcenſion with the Sun's Depreſſion below the Horizon, at the Time of that Star's* heliacal *Setting* (before its achronical Setting) *being given?*

Example. *The Month Day is required, in* 1760, *when the bright Star in the Eagle will ſet heliacally, at* London?

N. B. It will ſet *heliacally*, when the Sun has yet to deſcribe an Arc of the Ecliptic further to the Eaſtward, till he comes to his Place, at the Star's *achronical* Setting from his preſent Place of 13° below the Horizon, or ſo much more to the Weſtward, than he will be at the Star's achronical Setting: And therefore the *heliacal* is before the Time of the *achronical* Setting.

The firſt *Method*, in the former Queſtion, determines the *heliacal Riſing and Setting* at once, independent of the *coſmical Riſing*, and *achronical Setting*, which Method is repeated in determining the heliacal Setting, at once, as follows.

	°	′	″
Oblique Deſcenſion of the bright Star in the *Eagle*, before found, p. 246. at Setting, *achronically*	305	17	9
Add 90° +	90	0	0
Sum (rejecting 360° R. A. of Mid-Heaven from ♈ following)	35	17	9
Longitude of Mid-Heaven correſpondent from ♈ following (by Queſt. 34.)	37	39	4
Meridian ∠ correſpondent (by Tab. p. 23, or 35 Queſt.)	71	1	28
Declination Mid-Heaven N. correſpondent (by Tab. p. 23, or 36 Queſt.)	14	5	0
Mid-Heaven Zenith Diſt. *London*	37	27	0
Angle of Ecliptic and Horizon	54	53	55

By PROPORTION.

		Logarithms.
As Radius	90°	10.0000000
To Tang. Mid-Heaven Zenith Diſt.	37 27 0	9.8841956
So Coſ. Merid. Angle correſpondent	71 1 28	9.5121035
To Tang. 4th Arc	13 59 7	9.3962991

				Logarithms.
And, As Coſ. Mid-H. Zen. Diſt.	37	27	0 co.	0.1002428
To Coſ. Sun's Zen. Diſt. at 13° Depreſ.	77	0	0	9.3520880
Supplement of Arcs muſt be taken	103	0	0	
So Coſ. 4th Arc	13	59	7	9.9869320
To Coſine	74	2	26	9.4392628
Supplement 5th Arc	105	57	34	
Dif. between 4th and 5th Arc	91	58	27	Ecliptic Arc required.

Place Mid-Heaven.	♋, ♌, ♍, ♎, ♏, ♐,	Sum.	4th and 5th Arcs for Weſt Side Meridian or Setting.
	♑, ♒, ♓, ♈, ♉, ♊,	Dif.	

Or to find the Arch of the Ecliptic below the Horizon, intercepted betwixt it and the Sun's Place.

As S. ∠ of Horizon and Ecliptic	54° 53′ 55″ co.	0.0871746
To S. Sun's Depreſſion	13 0 0	9.3520880
So Radius	S. 90 0 0	10.0000000
To S. Ecliptic Arc *below* the Horizon	15 57 34	9.4392626

To find the Arc of the Ecliptic *between the Meridian and Horizon?*

As S. ∠ of Ecliptic and Horizon	54° 53′ 55″ co.	0.0871746
To Coſ. Zen. Diſt. of Mid-Heaven, or S. Alt. of Mid-Heaven	37 27 0	9.8997572
So Radius	Sine 90°	10.0000000
To S. Arc of Ecliptic between Meridian and Horizon	76 0 53	9.9869318
Arc below the Horizon before found	15 57 34	

Sum, Ecliptic Arc betwixt the Merid. and Sun, at the ✱'s *heliacal* Setting	91 58 27, *as before.*
	Deduct fr. Long. Mid-Heaven, [adding 360°.
Long. of Mid-Heaven	37 39 4 from ♈.
Remain, Long. Sun, at the Star's Setting heliacally	305 40 37
To ♒ 10ˢ Deduct	300 0 0
Sun's Place	♒ 5 40 37
Or Sun's *Place* at *achronical* Setting, before found, p. 246.	♒ 21 38 11
Arch of the *Ecliptic* below the Horizon, at 13° Sun's Depreſſion, before *achronical* Setting ſub.	15 57 34
Sun's Place Remains in	♒ 5 40 37 *as before.*

Which Place *anſwers to* January 25, 1760, *when the bright Star in the* Eagle *ſets* heliacally, *in moſt Places about the Middle of* England, *and will continue to ſet heliacally, on that Day, for a Number of Years.* So that *December* 26 (the Time of this Star's heliacally Riſing) is the Time of its firſt Appearance, in the Morning, after being hid under the Sun's Rays in the Day Time; which Star, from that Time, continues to appear in the Morning, before Sun-Riſe; alſo appears in the Evening, after Sun-ſet, till the 25th of *January* following, when it laſt appears in the Evening, ſetting *heliacally*. It then comes again into the Sun's Rays, as he further advances to the *Eaſtward*, ſetting *achronically* with him, on *February* 9th, and then ſets before him.

The

Aſtronomical QUESTIONS practically anſwered.

The Times of *heliacal* Riſing and Setting of any other *fixed Star*, may be determined by the foregoing *general Method*, which equally ſerves for finding the *heliacal* Riſing and Setting of the Planets, by obſerving the Sun's Depreſſions at thoſe Times, as *follows.*

		Deg.	
♄	*can be ſeen*	11	below the Horizon.
♃	*at Riſing*	10	
♂	*or Setting*	11	
♀	*when the*	5	
☿	*Sun is*	10	
☽		5	

Likewiſe ♀ *may be ſeen in the Day.* ☿ *was ſeen in the Day,* April 22, 1715. ☽ *may be alſo ſeen in the Day.*

☞ The *chief* Uſe of the foregoing *coſmical, achronical,* and *heliacal* Riſing and Setting of the Stars and Planets *(otherwiſe called the Poetical Riſing and Setting thereof by the Antients)* is to direct us when and where to look for them, to make our Obſervations. —*But a* PAIR *of* Mr. SENEX's GLOBES, *ſold by* Mr. MARTIN, *in* Fleetſtreet, London, *according to his late Improvements, will ſatisfy us in theſe, and many other uſeful Enquiries with moſt Eaſe and Expedition; where great Accuracy is not required. Which* GLOBES *no Aſtronomer ought to be without, as they will ſerve to confirm the* Truth, *or diſcover an* Error, *in his Computations.*

OF THE MOON.

TO *find the Moon's right Aſcenſion at her given Time of Southing, on any given Day, the right Aſcenſion of the Sun, in Time, at the preceding Noon of that Day being alſo given?*

RULE. The Time of the Moon's Southing added to right Aſcenſion of the Sun, in Time, at the Time of her Southing, will be then equal to the right Aſcenſion of the Mid-heaven, or right Aſcenſion of the Moon then upon the Meridian.

Conſequently, by *Tranſpoſition.* If from right Aſcenſion of the Moon, in Time, on a given Day you deduct the right Aſcenſion of the Sun, in Time, (both at the Moon's Southing) the Remainder will be the *exact* Time of the Moon's Southing, paſt Noon, on that Day.

☞ Hence the Reaſon of firſt ſeeking the Moon's eſtimate Southing, by the common Methods of finding her true Southing.

EXAMPLE. *To find the Moon's right Aſcenſion at the Time of her Southing,* October 1, 1760?

	R. A. ☉.			
1760 *Oct.* 1	$12^h\ 31^m\ 59^s$	Moon ſouths 1760 *Oct.* 1.		$18^h\ 38^m$ paſt Noon.
Noon . . . 2	12 35 37	Sun's R. A. then		12 34 48 from below.
La Caille's Eph.	Dif. 3 38	Moon's R. A. then or R. A. Mid-heaven	Sum Rejecting 24 Hours.	7 12 48 = 108° 12′ (*by Tab. p.* 28.) from *Aries* following.

Now, As 24^h : $3^m\ 38^s$ Incr. R. A. :: $18^h\ 38^m$: $2^m\ 49^s$ +
Sun's R. A. *Oct.* 1. Noon 12^h 31 59

Sun's R. A. at Moon's next Southing $18^h\ 38^m$ paſt Noon. 12 34 48, in Time.

TO *find the* Moon's *right Aſcenſion at Noon, preceding the given Time of Moon's Southing?*

	☽ ſouths.
Sept. 30	$17^h\ 39^m$
1760 *Oct.* 1	18 38
Diurnal Dif. R. A. ☽ à ☉.	Dif. 59^m

Diurnal Dif. R. A. Sun . . . . . . 3 38 fr. above.

Diurnal Dif. R. A. Moon 62 38

	☽'s Pla.	Lat.	Decl.
By *La Caille's* Eph. 1760, *Oct.* 1.	5° ♋ 26′	2° N. 4′	25° N. 26′

As 24^h : $62^m\ 38^s$ :: $18^h\ 38^m$ ☽'s Southing ſince Noon to $48^m\ 53^s$
To be deducted from R. A. Moon, at Southing 7^h 12 48

Rem. Moon's R. A. 1760. *Oct.* 1. Noon . . $6^h\ 23^m\ 55^s$
By Tab. p. 28, in Degrees . . . . 95° 58′ 45″

Whence, by *Rule,* Queſt. 28. p. 227. R. A. ☽ 96° 0 52 fr. *Aries.*

Dif. — 1 7 Error.

N. B. *The diurnal Difference of the right Aſcenſion of the* ☽ à ☉ *from* 12 *to* 12 *is not exactly the ſame as the Difference of* ☽ à ☉ *from Southing to next Southing, thereby cauſing a ſmall Error, computing by the Difference of Southing, as appears above.*

EQUATION of the Ecliptic Right ASCENSION, to the Right ASCENSION with LATITUDE.

Longitude.	Lat. North ♈, ♉, ♊, Signs 0 1 2; South ♎, ♏, ♐, 6 7 8					Lat. South ♈, ♉, ♊, Signs 0 1 2; North ♎, ♏, ♐, 6 7 8				
	1°	3°	5°	7°	9°	1°	3°	5°	7°	9°
	−	−	−	−	−	+	+	+	+	+
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
♈♎	0 23	1 11	1 59	2 47	3 37	0 24	1 11	1 59	2 47	3 35
3	0 23	1 11	1 59	2 47	3 37	0 23	1 11	1 59	2 47	3 35
6	0 23	1 11	1 59	2 47	3 36	0 23	1 11	1 59	2 47	3 34
9	0 23	1 11	1 58	2 48	3 36	0 23	1 11	1 58	2 46	3 32
12	0 23	1 10	1 58	2 48	3 35	0 23	1 11	1 58	2 45	3 30
15	0 23	1 10	1 57	2 46	3 34	0 23	1 10	1 57	2 43	3 28
18	0 23	1 9	1 55	2 44	3 32	0 23	1 9	1 55	2 41	3 26
21	0 23	1 9	1 53	2 42	3 30	0 22	1 9	1 53	2 39	3 23
24	0 22	1 8	1 51	2 40	3 28	0 22	1 8	1 52	2 36	3 20
27	0 22	1 6	1 50	2 37	3 25	0 22	1 6	1 50	2 33	3 15
♉♏	0 21	1 5	1 49	2 35	3 22	0 22	1 4	1 47	2 28	3 10
3	0 20	1 3	1 47	2 31	3 18	0 21	1 3	1 44	2 25	3 5
6	0 20	1 2	1 44	2 28	3 13	0 20	1 2	1 42	2 21	2 59
9	0 20	1 1	1 42	2 24	3 9	0 19	0 59	1 38	2 15	2 54
12	0 19	0 58	1 38	2 19	3 3	0 19	0 57	1 34	2 10	2 45
15	0 18	0 55	1 33	2 13	2 55	0 19	0 55	1 31	2 6	2 39
18	0 17	0 55	1 30	2 8	2 48	0 18	0 52	1 27	2 0	2 31
21	0 17	0 51	1 26	2 2	2 39	0 17	0 49	1 21	1 54	2 22
24	0 16	0 48	1 21	1 55	2 29	0 16	0 47	1 17	1 47	2 13
27	0 15	0 45	1 16	1 48	2 20	0 15	0 44	1 12	1 39	2 4
♊♐	0 14	0 41	1 10	1 40	2 10	0 14	0 41	1 7	1 32	1 55
3	0 13	0 39	1 5	1 31	1 59	0 12	0 37	0 58	1 25	1 45
6	0 11	0 34	0 58	1 22	1 48	0 11	0 33	0 49	1 16	1 34
9	0 10	0 30	0 52	1 14	1 36	0 10	0 30	0 42	1 8	1 23
12	0 8	0 26	0 44	1 3	1 24	0 9	0 26	0 35	0 58	1 12
15	0 7	0 22	0 38	0 54	1 11	0 7	0 21	0 31	0 49	1 0
18	0 6	0 18	0 30	0 43	0 58	0 6	0 17	0 22	0 40	0 49
21	0 4	0 13	0 23	0 33	0 44	0 5	0 13	0 15	0 30	0 37
24	0 3	0 9	0 15	0 23	0 31	0 3	0 9	0 9	0 20	0 24
27	0 1	0 4	0 7	0 11	0 16	0 1	0 4	0 4	0 10	0 13
30	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
°	+	+	+	+	+	−	−	−	−	−
Longitude.	1°	3°	5°	5°	9°	1°	3°	5°	7°	9°
	Lat. South ♑, ♒, ♓, Signs 9 10 11; North ♋, ♌, ♍, 3 4 5					Lat. North ♑, ♒, ♓, Signs 9 10 11; South ♋, ♌, ♍, 3 4 5				

EQUATION to be subtracted fr. the Lat. of a Planet for the EQUATION of the Ecliptic Declin. to the Declin. with that Planet's LATITUDE.

Lat. N./S. ♈, ♉, ♊, ♋, ♌, ♍ +/− 1st Eq.						
1°	2°	3°	4°	5°	6°	Longitude.
−	−	−	−	−	−	
′	′	′	′	′	′	°
5	10	15	20	25	30	30
5	10	15	20	25	30	27
5	10	15	20	25	30	24
5	10	15	20	25	29	21
5	10	15	19	24	29	18
5	10	14	19	24	28	15
5	9	14	18	23	27	12
4	9	14	18	22	26	9
4	8	13	17	21	25	6
4	8	13	17	20	24	3
4	8	12	16	19	23	♓ ♍
4	8	11	15	18	22	27
4	7	10	14	17	21	24
3	6	9	13	16	20	21
3	6	9	12	15	18	18
3	6	8	11	14	17	15
3	5	7	10	13	16	12
3	5	6	9	12	14	9
2	4	6	8	10	13	6
2	4	5	7	9	11	3
2	3	4	6	7	9	♒ ♌
2	2	3	5	6	8	27
2	2	3	4	5	6	24
1	2	2	3	4	5	21
1	1	2	2	3	4	18
1	1	1	1	2	3	15
1	1	1	1	1	2	12
0	0	0	0	0	1	9
0	0	0	0	0	0	6
0	0	0	0	0	0	3
0	0	0	0	0	0	♑ ♋
−	−	−	−	−	−	0
1°	2°	3°	4°	5°	6°	Long.
Lat. S./N. ♎, ♏, ♐, ♑, ♒, ♓ +/− 1st Eq.						

The following **Practical Rules**, from whence the **above Equations** are deduced, are in IMITATION of the Shortness and Usefulness of the **Dean of Durham's** METHOD in finding the **Parallactic Angle**.

CONSTRUCTION. For Lat. North/South, Long. ♈, ♉, ♊ / ♎, ♏, ♐, Sigs. 0. 1. 2. / 6. 7. 8. — Eq.

Or Lat. South/North, Long. ♑, ♒, ♓ / ♋, ♌, ♍, Sigs. 9. 10. 11. / 3. 4. 5. + Eq.

PROPORTION.

		Logarithms.
As Radius	S. 90°	10.0000000
To Cos. ∠ of Eclip. and Meridian (♈ and ♎)	66°31′ 30″	9.6002636
So Tan. Lat.	9 0 0	9.1997125
To Tan. Dif. R. A. required	3°36′ 36″	8.7999761

For Lat. S/N, Lon. ♈ ♉ ♊ / ♎ ♏ ♐, Sigs. 0.1.2 / 6.7.8 + Eq. Or Lat. N/S, Lon. ♑ ♒ ♓ / ♋ ♌ ♍, Sigs. 9.10.11 / 3. 4. 5 — Eq.

As Radius	S. 90°	10.0000000
To Cos. ∠ of Eclip. and Meridian (♈ and ♎)	66°31′ 30″	9.6002636
So S. Latitude	9 0 0	9.1943324
To S. Dif. R. A. required	3 34 22	8.7945960

Example. *To find the Right Ascension and Declination answerable to Longitude* ♊ 5° 38′, *and Latitude* 4° 38′ 33″ S.?

Ecliptic R. A. (*by Tab. p.* 24) 63°43′ 15″
Eq. of R. A. to Lon. & Lat. + 44 0
R. A. required . . . 64 27 15

Eclip. Decl. (*by Tab. p.* 23) 21°16′ 32″N.
Equated Lat. by next Tab. — 4 34 33
Declination required . . 16 42 0 N.

Const. For Lat. N./S. ♈, ♉, ♊, ♋, ♌, ♍ / ♎, ♏, ♐, ♑, ♒, ♓ + *1st Eq.*

PROPORTION.

		Logarithms.
As Rad.	S. 90°	10.0000000
To S. ∠ of Eclip. and Meridian (♈ and ♎)	66°31′ 30″	9.9624801
So S. Lat.	6 0 0	9.0192346
To S. Difference Declin. req.	5 30 7	8.9817147
	6 0 0	
	29′ 53″	

For Lat. S./N. ♈, ♉, ♊, ♋, ♌, ♍ / ♎, ♏, ♐, ♑, ♒, ♓ — *1st Eq.*

As Rad.	S. 90°	10.0000000
To S. ∠ of Eclip. and Merid. (♈ and ♎)	66°31′ 30″	9.9624801
So Tan. of Lat.	6 0 0	9.0216202
To Tang. Dif. Decl. req.	5 33 34	8.9841003
	6 0 0	
	26′ 26″	

Ex. *To find the Declination answerable to Long.* 28° 11′ ♏, *and Lat.* 2° 34′ N.?

Ecliptic Declination 19°47′ 5″ S. by Tab. p. 23.
— 4′ from the Lat. 2° 34′ N. . . = 2 30 0 — Lat. equated, by *Table* above.

Remain 17 17 5 S. Declination reqd.

A TABLE of near LONGITUDE and RIGHT ASCENSION of the MID-HEAVEN, with the near *Longitude* of the NONAGESIMAL or 90 DEGREE of the ECLIPTIC from the *Horizon*, correspondent. For Latitude LONDON, 51° 32′.

Long.	♈ R. A. Mid Hea.	Longitude Non. Deg. ♈.	♉ R. A. Mid-Hea.	Longitude Non. Deg. ♉.	♊ R. A. Mid-Hea.	Longitude Non. Deg. ♊.	♋ R. A. Mid-Hea.	Longitude Non. Deg. ♋.	♌ R. A. Mid-Hea.	Longitude Non. Deg. ♋.	♍ R. A. Mid-Hea.	Longitude Non. Deg. ♌.
°	° ′	° ′	° ′	° ′	° ′	° ′	°	° ′	°	° ′	°	° ′
0	0 0	26♈42	27 54	16♉31	57 48	7♊22	90	0♋ 0	122	22♋38	152	13♌30
1	0 55	27 23	28 51	17 11	58 51	8 6	91	0 47	123	23 32	153	14 9
2	1 50	28 2	29 49	17 51	59 54	8 50	92	1 33	124	24 5	154	14 49
3	2 45	28 42	30 46	18 31	60 57	9 34	93	2 19	125	24 48	155	15 29
4	3 40	29 21	31 44	19 12	62 0	10 18	94	3 5	126	25 32	156	16 9
5	4 35	0♉ 1	32 42	19 52	63 3	11 3	95	3 51	127	26 16	157	16 48
6	5 30	0 40	33 40	20 32	64 6	11 47	96	4 37	128	26 58	158	17 28
7	6 25	1 20	34 39	21 13	65 10	12 31	97	5 23	129	27 41	159	18 8
8	7 21	2 0	35 37	21 24	66 13	13 16	98	6 9	130	28 22	160	18 47
9	8 16	2 39	36 36	22 25	67 17	14 1	99	6 55	131	29 6	161	19 27
10	9 11	3 19	37 35	23 16	68 18	14 46	100	7 40	132	29 47	162	20 6
11	10 6	3 59	38 34	23 57	69 45	15 31	101	8 26	133	0♌30	162	20 46
12	11 2	4 38	39 33	24 38	70 29	16 16	103	9 12	134	1 13	163	21 26
13	11 57	5 17	40 32	25 19	71 34	17 1	104	9 57	135	1 55	164	22 5
14	12 53	5 57	41 32	26 0	72 38	17 46	105	10 43	136	2 36	165	22 45
15	13 48	6 36	42 31	26 42	73 43	18 32	106	11 28	137	3 18	166	23 24
16	14 44	7 15	43 31	27 24	74 47	19 17	107	12 14	138	4 0	167	24 4
17	15 40	7 55	44 31	28 6	75 52	20 4	108	12 59	139	4 41	168	24 43
18	16 36	8 35	45 32	28 47	76 57	20 49	109	13 45	140	5 22	169	25 23
19	17 31	9 14	46 32	29 30	78 2	21 35	110	14 30	141	6 4	170	26 2
20	18 27	9 54	47 33	0♊13	79 7	22 20	111	15 14	142	6 45	171	26 41
21	19 24	10 33	48 33	0 55	80 12	23 6	112	15 59	143	7 26	172	27 22
22	20 20	11 12	49 34	1 37	81 17	23 51	113	16 44	144	8 6	173	28 1
23	21 16	11 52	50 35	2 20	82 22	24 37	114	17 29	145	8 47	174	28 40
24	22 13	12 32	51 37	3 2	83 28	25 23	115	18 14	146	9 28	174	29 20
25	23 9	13 12	52 38	3 46	84 33	26 9	116	18 58	147	10 8	175	29 50
26	24 6	13 52	53 40	4 29	85 38	26 35	118	19 42	148	10 48	176	0♍39
27	25 2	14 32	54 42	5 12	86 44	27 41	119	20 26	149	11 29	177	1 19
28	26 0	15 12	55 44	5 55	87 49	28 27	120	21 10	150	12 9	178	2 0
29	26 57	15 51	56 46	6 39	88 55	29 13	121	21 54	151	12 50	179	2 30
30	27 54	16 31	57 48	7 22	90 0	♋ 0	122	22 38	152	13 30	180	3 19

Long.	♎ R. A. Mid-Hea	Longitude Non. Deg.	♏ R. A. Mid-Hea.	Longitude Non. Deg	♐ R. A. Mid-Hea.	Longitude Non. Deg.	♑ R. A. Mid-Hea.	Longitude Non. Deg.	♒ R. A. Mid-Hea.	Longitude Non. Deg.	♓ R. A. Mid-Hea.	Longitude Non. Deg.
0	180	3♍19	208	25♍15	238	27♎10	270	0♑ 0	302	2♓50	332	4♈45
1	181	3 59	209	26 5	239	28 37	271	2 37	303	4 14	333	5 35
2	182	4 40	210	26 56	240	0♏ 6	272	5 19	304	5 37	334	6 23
3	183	5 20	211	27 47	241	1 37	273	7 55	305	6 58	335	7 12
4	184	6 2	212	28 39	242	3 11	274	10 29	306	8 17	336	8 0
5	185	6 48	213	29 31	243	4 48	275	13 2	307	9 33	337	8 48
6	186	7 24	214	0♎24	244	6 27	277	15 37	308	10 49	338	9 35
7	186	8 5	215	1 19	245	8 8	278	18 7	309	12 3	339	10 22
8	187	8 46	216	2 13	246	9 52	279	20 35	310	13 14	340	11 7
9	188	9 20	217	3 10	247	11 40	280	23 0	311	14 24	341	11 52
10	189	10 10	218	4 6	248	13 30	281	25 22	312	15 32	342	13 37
11	190	10 52	219	5 5	249	15 20	282	27 43	313	16 40	342	13 23
12	191	11 35	220	6 1	250	17 10	283	0♒ 0	314	17 46	343	14 7
13	192	12 18	221	7 0	252	19 18	284	2 16	315	18 53	344	14 51
14	193	12 50	222	8 0	253	21 20	285	4 27	316	19 56	345	15 35
15	194	13 43	223	9 2	254	23 30	286	6 33	317	20 58	346	16 17
16	195	14 26	224	10 6	255	25 32	287	8 39	318	22 0	347	17 1
17	196	15 10	225	11 10	256	27 44	288	10 43	319	23 0	348	17 44
18	197	15 54	226	12 14	257	29 58	289	12 42	320	23 59	349	18 26
19	198	16 39	227	13 21	258	2♐17	291	14 40	321	24 58	350	19 9
20	198	17 23	228	14 29	259	4 38	292	16 31	322	25 55	351	19 52
21	199	18 8	229	15 37	260	7 0	293	18 20	323	26 51	352	20 33
22	200	18 54	230	16 46	261	9 24	294	20 5	224	27 47	353	21 15
23	201	19 30	231	17 58	262	11 53	295	21 52	325	28 41	354	21 56
24	202	20 26	232	19 11	263	14 23	296	23 33	326	29 36	354	22 37
25	203	21 14	233	20 27	265	16 59	297	25 13	327	0♈29	355	23 18
26	204	22 1	234	21 43	266	19 20	298	26 49	328	1 32	356	23 59
27	205	22 40	235	23 3	267	22 5	299	28 22	329	2 14	357	24 39
28	206	23 37	236	24 24	268	24 39	300	29 54	330	3 5	358	25 11
29	207	24 20	237	25 47	269	27 20	301	1♓23	331	3 56	359	26 6
30	208	25 15	238	27 10	270	0♑ 0	302	2 30	332	4 45	360	26 42

N. B. The *Nonagesimal* or 90 Degree of the Ecliptic from the Horizon, is the highest Point of the Ecliptic at that Time, whose Altitude is therefore always equal to the ∠ of the Ecliptic and Horizon, which is also equal to the Zenith-Distance of the elevated *Pole* of the Ecliptic, at that Time.

A TABLE for determining the *near Time*, in any Day, when the SUN, MOON, a PLANET, or STAR, is in the highest *Point* of the Ecliptic. For Latitude *London*.

Argument. SUN's Place at Noon, or Planet's Longitude at Southing.

Sun's Place.	♈ 0ˢ Point of Ascendant ° ′	♈ 0ˢ R. A. in Time. h m	♉ 1ˢ Point of Ascendant ° ′	♉ 1ˢ R. A. in Time. h m	♊ 2ˢ Point of Ascendant ° ′	♊ 2ˢ R. A. in Time. h m	♋ 3ˢ Point of Ascendant ° ′	♋ 3ˢ R. A. in Time. h m	♌ 4ˢ Point of Ascendant ° ′	♌ 4ˢ R. A. in Time. h m	♍ 5ˢ Point of Ascendant ° ′	♍ 5ˢ R. A. in Time. h m
0	26♋42	0 0	16♌31	1 52	7♍22	3 51	0♎0	6 0	22♎38	8 9	13♏30	10 8
1	27 23	0 4	17 11	1 55	8 6	3 55	0 47	6 4	23 22	8 13	14 9	10 12
2	28 2	0 7	17 51	1 59	8 50	4 0	1 33	6 9	24 5	8 17	14 49	10 16
3	28 42	0 11	18 31	2 3	9 34	4 4	2 19	6 13	24 48	8 21	15 29	10 20
4	29 21	0 15	19 12	2 7	10 18	4 8	3 5	6 17	25 32	8 25	16 9	10 24
5	0♌1	0 18	19 52	2 11	11 3	4 12	3 51	6 22	26 16	8 29	16 48	10 27
6	0 40	0 22	20 32	2 15	11 47	4 16	4 37	6 26	26 58	8 34	17 28	10 31
7	1 20	0 26	21 13	2 19	12 31	4 21	5 23	6 31	27 41	8 38	18 8	10 35
8	2 0	0 29	21 54	2 22	13 16	4 25	6 9	6 35	28 22	8 42	18 47	10 39
9	2 39	0 33	22 25	2 26	14 1	4 29	6 55	6 39	29 6	8 46	19 27	10 42
10	3 19	0 37	23 16	2 30	14 46	4 33	7 40	6 44	29 47	8 50	20 6	10 46
11	3 59	0 40	23 57	2 34	15 31	4 38	8 26	6 48	0♏30	8 54	20 [illegible]	10 50
12	4 38	0 44	24 38	2 38	16 16	4 42	9 12	6 52	1 13	8 58	21 26	10 54
13	5 17	0 48	25 19	2 42	17 1	4 46	9 57	6 57	1 55	9 2	22 5	10 57
14	5 57	0 51	26 0	2 46	17 46	4 51	10 43	7 1	2 36	9 6	22 45	11 1
15	6 36	0 55	26 42	2 50	18 32	4 55	11 28	7 5	3 18	9 10	23 24	11 5
16	7 15	0 59	27 24	2 54	19 17	5 0	12 14	7 9	4 0	9 14	24 4	11 9
17	7 55	1 2	28 6	2 58	20 4	5 4	12 59	7 14	4 41	9 18	24 43	11 12
18	8 35	1 6	28 47	3 2	20 49	5 8	13 45	7 18	5 22	9 21	25 23	11 16
19	9 14	1 10	29 30	3 6	21 35	5 12	14 30	7 22	6 4	9 26	26 2	11 20
20	9 54	1 14	0♍13	3 10	22 20	5 16	15 14	7 27	6 45	9 30	26 41	11 24
21	10 33	1 18	0 55	3 14	23 6	5 21	15 59	7 31	7 26	9 34	27 22	11 27
22	11 12	1 21	1 37	3 18	23 51	5 25	16 44	7 35	8 6	9 38	28 1	11 31
23	11 52	1 25	2 20	3 22	24 37	5 29	17 29	7 39	8 47	9 41	28 40	11 34
24	12 32	1 29	3 2	3 26	25 23	5 34	18 14	7 44	9 28	9 43	29 20	11 38
25	13 12	1 33	3 46	3 31	26 9	5 38	18 58	7 48	10 8	9 49	29 50	11 42
26	13 52	1 36	4 29	3 35	26 55	5 43	19 42	7 52	10 48	9 53	0♐30	11 45
27	14 32	1 40	5 12	3 39	27 41	5 47	20 26	7 56	11 29	9 57	1 19	11 49
28	15 12	1 44	5 55	3 43	28 27	5 51	21 10	8 0	12 9	10 1	2 0	11 53
29	15 51	1 48	6 39	3 47	29 13	5 56	21 54	8 5	12 50	10 5	2 30	11 56
30	16 31	1 52	7 22	3 51	30 0	6 0	22 38	8 9	13 30	10 8	3 10	12 0

Sun's Place.	♎ 6ˢ Point of Ascendant ° ′	♎ 6ˢ R. A. in Time. h m	♏ 7ˢ Point of Ascendant ° ′	♏ 7ˢ R. A. in Time. h m	♐ 8ˢ Point of Ascendant ° ′	♐ 8ˢ R. A. in Time. h m	♑ 9ˢ Point of Ascendant ° ′	♑ 9ˢ R. A. in Time. h m	♒ 10ˢ Point of Ascendant ° ′	♒ 10ˢ R. A. in Time. h m	♓ 11ˢ Point of Ascendant ° ′	♓ 11ˢ R. A. in Time. h m
0	3♐19	12 0	25♐15	13 52	27♑10	15 51	0♈0	18 0	2♊50	20 9	4♋45	22 8
1	3 59	12 4	26 5	13 55	28 37	15 55	2 37	18 4	4 14	20 13	5 35	22 12
2	4 40	12 7	26 56	13 59	0♒6	16 0	5 19	18 4	5 37	20 17	6 23	22 16
3	5 20	12 11	27 47	14 3	1 37	16 4	7 55	18 13	6 58	20 21	7 12	22 20
4	6 2	12 15	28 39	14 7	3 11	16 8	10 29	18 17	8 17	20 25	8 0	22 24
5	6 48	12 18	29 31	14 11	4 48	16 12	13 2	18 22	9 33	20 29	8 48	22 27
6	7 24	12 22	0♑24	14 15	6 27	16 16	15 37	18 26	10 49	20 33	9 35	22 31
7	8 5	12 26	1 19	14 19	8 8	16 21	18 7	18 31	12 3	20 38	10 22	22 35
8	8 46	12 29	2 13	14 22	9 52	16 25	20 35	18 35	13 14	20 42	11 7	22 39
9	9 28	12 33	3 10	14 26	11 40	16 29	23 0	18 39	14 24	20 46	11 52	22 42
10	10 10	12 37	4 6	14 30	13 30	16 33	25 22	18 44	15 32	20 50	12 37	22 46
11	10 52	12 40	5 5	14 34	15 20	16 38	27 43	18 48	16 40	20 54	13 23	22 50
12	11 35	12 44	6 1	14 38	17 19	16 42	30 0	18 52	17 46	20 58	14 7	22 54
13	12 18	12 48	7 0	14 42	19 18	16 46	2♉16	18 57	18 53	21 2	14 51	22 57
14	12 50	12 51	8 0	14 46	21 20	16 51	4 27	19 1	19 56	21 6	15 [illegible]	23 1
15	13 43	12 55	9 2	14 50	23 30	16 55	6 33	19 5	20 58	21 10	[illegible] 17	23 5
16	14 26	12 59	10 6	14 54	25 32	16 59	8 39	19 9	22 0	21 14	17 1	23 9
17	15 10	13 3	11 9	14 58	27 44	17 3	10 43	19 14	23 0	21 18	17 44	23 12
18	15 54	13 6	12 14	15 2	29 58	17 8	12 45	19 18	23 59	21 22	18 26	23 16
19	16 39	13 10	13 21	15 6	2♓17	17 12	14 40	19 22	24 58	21 26	19 9	23 20
20	17 23	13 14	14 29	15 10	4 38	17 16	16 31	19 27	25 55	21 30	19 52	23 23
21	18 8	13 18	15 37	15 14	7 0	17 21	18 20	19 31	26 51	21 34	20 33	23 27
22	18 54	13 21	16 46	15 18	9 24	17 25	20 5	19 35	27 47	21 38	21 15	23 31
23	19 39	13 25	17 58	15 22	11 53	17 29	21 52	19 39	28 41	21 41	21 56	23 34
24	20 26	13 19	19 11	15 26	14 23	17 34	23 33	19 44	29 36	21 45	22 37	23 38
25	21 14	13 33	20 27	15 31	16 59	17 38	25 13	19 48	0♋29	21 49	23 18	23 42
26	22 1	13 36	21 23	15 35	19 30	17 43	26 49	19 52	1 22	21 53	23 59	23 45
27	22 47	13 40	23 3	15 39	22 5	17 47	28 22	19 56	2 14	21 57	24 30	23 49
28	23 36	13 44	24 24	15 43	24 29	17 51	29 54	20 0	3 5	22 1	25 21	23 53
29	24 26	13 48	25 47	15 47	27 20	17 56	1♊23	20 5	3 56	22 5	26 2	23 50
30	25 15	13 52	27 10	15 51	30 0	18 0	2 50	20 9	4 45	22 8	26 42	24 0

Construction. The above Table contains the right Ascensions, in Time, of the Mid-Heaven, correspondent to the several Ascendent Point of the Ecliptic at the Horizon, and the right Ascension of the Mid-Heaven, in Degrees, at Noon, or Southing.

RULES and EXAMPLES for finding when the SUN, MOON, PLANETS, and STARS, will be in the Nonagesimal DEGREE.

And, therefore, the *Difference* of right Ascension, in Time, correspondent to the right Ascension of the *Mid-Heaven* to the Ascendant at *Noon*, or *Southing*, of the *Sun*, *Moon*, *Planet* or *Star*, and the right Ascension of the Mid-Heaven, correspondent to the *Ascendant* of the *Nonagesimal* Degree, will be the Time from Noon, or Southing, when the *Sun*, *Moon*, *Planet*, or *Star*, will be in the *Nonagesimal* Degree, or highest Point of the Ecliptic, *required*.

EXAMPLE I. *Required the Time when the* SUN *will be in the* Nonagesimal *Degree*, July 15, 1764?

RULE. *Take out the right Ascension in Time to the Sun's Place at Noon, or Place of the* Moon, Planet, *or* Star, *at Southing. Then add* 3 *Signs to the Sun's Place at Noon, or to the Moon's Planet, or Star's Place at Southing*, (taken also for the Place of the Nonagesimal Degree) *and the* Sum *will be the Point of the Ecliptic, or Ascendant at the Horizon of* London, (*supposing no Change of Place from Noon, or Southing, to the Nonagesimal* Degree) *correspondent to which* Ascendant *take out the right Ascension of the Mid-Heaven, in Time, and place it under the former right Ascension of the Mid-Heaven, at Noon, or Southing, and the Difference will be the Time of the Nonagesimal Degree, past or before Noon for the Sun, or past or before Southing for the Planets, required. If which Time be added to or subtracted from the Time of Southing of the Planets, according as it is before or after Southing, you will have the Time of their being in the* Nonagesimal *Degree, respectively, required.*

Sun's Place at Noon ♋ 23° 18′ 41″ Right Ascension Mid-Heaven correspondent 7^h 40^m 40^s
Add 3^s 0 0 0

The Ascendant to the *Nonagesimal* Deg. having nearly the Sun's Place at Noon, at that Time. ♎ 23 18 41 R. A. Mid-Heaven correspondt. by the *Table* 8 12 44

Dif. R. Ascension or Time, *past Noon*, when the Sun is in the 90 Deg. or highest Point of Ecliptic, for that Day. 32^m 4^s

N. B. When the right Ascension of Mid-Heaven at Noon, or Southing in Time, is *less* than the right Ascension of Mid-Heaven to the Ascendant of the Nonagesimal Degree, then the Difference of right Ascensions, or Time of Nonagesimal Degree is past Noon, or Southing; but if the right Ascension of the Mid-Heaven, at Noon, or Southing, in Time, is more than the right Ascension of Mid-Heaven to the Ascendant of the Nonagesimal Degree, then the Difference of right Ascensions or Time of Nonagesimal Degree is before Noon, or Southing.

EXAMPLE II. *To find the Time of the Sun being in the Nonagesimal Degree*, 17*th of* April, 1764?

Sun's Place at Noon ♈ 27° 54′ 19″ . . . . Right Ascension Mid-Heaven correspondent 1^h 43^m 38^s
Add . . 3^s 0 0 0

The Ascendant to the Place of the Nonag. Degree having nearly the same Place with the Sun at Noon . . . . ♋ 27 54 19 . . . . Right Ascension Mid-Heaven correspondent, by the Table 0 6 23

Dif. R. Ascensions, or Time before Noon, when the Sun is in the 90 Deg. — 1 37 15
12 0 0

Viz. Hour before Noon . . 10 22 45
Or Time past former Noon . . . . . by deducting the Right Ascension Mid-Heaven at Noon, fr. R. A. to Mid-H. of Ascend. of the Nonag. Deg. first adding 24 Hours. 22 22 15

N. B. You may always deduct the R. A. of Mid-Heaven at Noon, from the R. A. of Mid-Heaven to the Ascendant, to the Nonag. Deg. for the Time past the present or former Day's Noon.

EXAMPLE III. *To find the Time when the Moon will be in the Nonagesimal Degree*, January 23, 1763?

Moon's Place at Noon ♑ 15° 24′ . . . . R. A. Mid-Heaven correspondent 19^h 6^m 36^s
Add 3^s 0 0

The Ascendant to the Place of Nonag. Deg. being supposed the same then with the Moon's Place. ♈ 0 15 24 . . . . . . R. A. Mid-Heaven correspondent 18 25 43

Dif. R. Ascensions or Time before the Moon souths when she is in the Nonagesf. Deg. — 40 53
Moon souths *Jan.* 23, 1763, Noon . . 12 0 0

Moon in the *Nonagesimal* Degree, required. 11 19 7
Forenoon.

N. B. *The Change of the Moon's Place before or after her Southing to the Nonagesf. Degree should be allowed for, when considerable.*

EXAMPLE

RULES and EXAMPLES for finding when the SUN, MOON, PLANETS, or STARS, will be in the Nonagesimal DEGREE.

EXAMPLE IV. *To find the Time when the Moon will be in the* Nonagesimal *Degree,* November 19, 1763?

Moon's Place at Noon ♉ 13° 23′ . . . . R. A. Mid-Heaven, correspondent 2^h 44^m
Add 3^s 0 0

The Ascendant to the Place of the Nonag. Deg. supposed the same with the Moon's Place at Noon. ♌ 4 13 23 . . . . R. A. Mid-Heaven correspondent 0 41

Dif. R. Ascensions, or Time before Moon souths, when she is in Nonag. —2 3

But the Moon not being in the same Place, Say, As 24^h : 12° 7′ Moon's diur. Mot. :: 2^h 4^m estimate Time at Nonag. Deg. before Southing : 1° 2′ Change of Moon's Place less than at Southing.

Moon souths *Nov.* 19, 1763, *London* . . 11 22 P. M.

Moon in the *Nonag.* Degree, required . . 9 19 Night.

Hence, the Ascendant then will be ♌ 4° 13′ 23″
— 1 2 0

♌ 3 11 23 . . . . R. A. Mid-Heaven correspondent — 37^m

Time before Moon souths when she is in Nonagesf. 2 7
Moon in the *Nonagesimal* Deg. 9 15 Night,
more nearly.

EXAMPLE V. *To find the Time when Mars will be in the Nonagesimal Degree,* September 28, 1762?

Place ♂ at Noon ♐ 13° 32′ . . . . R. A. Mid-Heaven correspondent 16^h $48^m\frac{1}{2}$
Add 3^s 0 0

The Ascendant to the Place of Nonag. Deg. being the same then supposed with Pl. ♂. ♓ 13 32 . . . . R. A. Mid-Heaven correspondent 17 32 $\frac{1}{4}$

Dif. R. Ascensions, or Time past Southing, when ♂ is in the *Nonagesf.* Degree . . 0 43 $\frac{3}{4}$
Add, ♂ souths *Sept.* 28, 1762, *London* 4 28 P. M.

♂ in Nonagesimal Deg. P. M. 5 11 $\frac{3}{4}$
[required.

☞ *The same Method serves for finding the Time when any Star is in the Nonagesimal Degree; the foregoing Examples being sufficient for all Cases.*

Here follow

Sexagesimal Tables:

Proportioning the

Difference of EQUATIONS

At SIGHT.

A SEXAGESIMAL TABLE for proportioning the DIFFERENCE of EQUATIONS at Sight: Being the PRODUCT of Sexagesimals.
N. B. Minutes × d by Minutes produce Seconds in ′ and ″; Minutes by Seconds, or Seconds by Minutes, produce Thirds, in ″ and ‴; and Seconds by Seconds produce Fourths, in ‴ and iv.

″×″	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv
′×″	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴
′×′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
″ ′	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	0 10	0 11	0 12	0 13	0 14	0 15
2	0 2	0 4	0 6	0 8	0 10	0 12	0 14	0 16	0 18	0 20	0 22	0 24	0 26	0 28	0 30
3	0 3	0 6	0 9	0 12	0 15	0 18	0 21	0 24	0 27	0 30	0 33	0 36	0 39	0 42	0 45
4	0 4	0 8	0 12	0 16	0 20	0 24	0 28	0 32	0 36	0 40	0 44	0 48	0 52	0 56	1 0
5	0 5	0 10	0 15	0 20	0 25	0 30	0 35	0 40	0 45	0 50	0 55	1 0	1 5	1 10	1 15
6	0 6	0 12	0 18	0 24	0 30	0 36	0 42	0 48	0 54	1 0	1 6	1 12	1 18	1 24	1 30
7	0 7	0 14	0 21	0 28	0 35	0 42	0 49	0 56	1 3	1 10	1 17	1 24	1 31	1 38	1 45
8	0 8	0 16	0 24	0 32	0 40	0 48	0 56	1 4	1 12	1 20	1 28	1 36	1 44	1 52	2 0
9	0 9	0 18	0 27	0 36	0 45	0 54	1 3	1 12	1 21	1 30	1 39	1 48	1 57	2 6	2 15
10	0 10	0 20	0 30	0 40	0 50	1 0	1 10	1 20	1 30	1 40	1 50	2 0	2 10	2 20	2 30
11	0 11	0 22	0 33	0 44	0 55	1 6	1 17	1 28	1 39	1 50	2 1	2 12	2 23	2 34	2 45
12	0 12	0 24	0 36	0 48	1 0	1 12	1 24	1 36	1 48	2 0	2 12	2 24	2 36	2 48	3 0
13	0 13	0 26	0 39	0 52	1 5	1 18	1 31	1 44	1 57	2 10	2 23	2 36	2 49	3 2	3 15
14	0 14	0 28	0 42	0 56	1 10	1 24	1 38	1 52	2 6	2 20	2 34	2 48	3 2	3 16	3 30
15	0 15	0 30	0 45	1 0	1 15	1 30	1 45	2 0	2 15	2 30	2 45	3 0	3 15	3 30	3 45
16	0 16	0 32	0 48	1 4	1 20	1 36	1 52	2 8	2 24	2 40	2 56	3 12	3 28	3 44	4 0
17	0 17	0 34	0 51	1 8	1 25	1 42	1 59	2 16	2 33	2 50	3 7	3 24	3 41	3 58	4 15
18	0 18	0 36	0 54	1 12	1 30	1 48	2 6	2 24	2 42	3 0	3 18	3 36	3 54	4 12	4 30
19	0 19	0 38	0 57	1 16	1 35	1 54	2 13	2 32	2 51	3 10	3 29	3 48	4 7	4 26	4 45
20	0 20	0 40	1 0	1 20	1 40	2 0	2 20	2 40	3 0	3 20	3 40	4 0	4 20	4 40	5 0
21	0 21	0 42	1 3	1 24	1 45	2 6	2 27	2 48	3 9	3 30	3 51	4 12	4 33	4 54	5 15
22	0 22	0 44	1 6	1 28	1 50	2 12	2 34	2 56	3 18	3 40	4 2	4 24	4 46	5 8	5 30
23	0 23	0 46	1 9	1 32	1 55	2 18	2 41	3 4	3 27	3 50	4 13	4 36	4 59	5 22	5 45
24	0 24	0 48	1 12	1 36	2 0	2 24	2 48	3 12	3 36	4 0	4 24	4 48	5 12	5 36	6 0
25	0 25	0 50	1 15	1 40	2 5	2 30	2 55	3 20	3 45	4 10	4 35	5 0	5 25	5 50	6 15
26	0 26	0 52	1 18	1 44	2 10	2 36	3 2	3 28	3 54	4 20	4 46	5 12	5 38	6 4	6 30
27	0 27	0 54	1 21	1 48	2 15	2 42	3 9	3 36	4 3	4 30	4 57	5 24	5 51	6 18	6 45
28	0 28	0 56	1 24	1 52	2 20	2 48	3 16	3 44	4 12	4 40	5 8	5 36	6 4	6 32	7 0
29	0 29	0 58	1 27	1 56	2 25	2 54	3 23	3 52	4 21	4 50	5 19	5 48	6 17	6 46	7 15
30	0 30	1 0	1 30	2 0	2 30	3 0	3 30	4 0	4 30	5 0	5 30	6 0	6 30	7 0	7 30
31	0 31	1 2	1 33	2 4	2 35	3 6	3 37	4 8	4 39	5 10	5 41	6 12	6 43	7 14	7 45
32	0 32	1 4	1 36	2 8	2 40	3 12	3 44	4 16	4 48	5 20	5 52	6 24	6 56	7 28	8 0
33	0 33	1 6	1 39	2 12	2 45	3 18	3 51	4 24	4 57	5 30	6 3	6 36	7 9	7 42	8 15
34	0 34	1 8	1 42	2 16	2 50	3 24	3 58	4 32	5 6	5 40	6 14	6 48	7 22	7 56	8 30
35	0 35	1 10	1 45	2 20	2 55	3 30	4 5	4 40	5 15	5 50	6 25	7 0	7 35	8 10	8 45
36	0 36	1 12	1 48	2 24	3 0	3 36	4 12	4 48	5 24	6 0	6 36	7 12	7 48	8 24	9 0
37	0 37	1 14	1 51	2 28	3 5	3 42	4 19	4 56	5 33	6 10	6 47	7 24	8 1	8 38	9 15
38	0 38	1 16	1 54	2 32	3 10	3 48	4 26	5 4	5 42	6 20	6 58	7 36	8 14	8 52	9 30
39	0 39	1 18	1 57	2 36	3 15	3 54	4 33	5 12	5 51	6 30	7 9	7 48	8 27	9 6	9 45
40	0 40	1 20	2 0	2 40	3 20	4 0	4 40	5 20	6 0	6 40	7 20	8 0	8 40	9 20	10 0
41	0 41	1 22	2 3	2 44	3 25	4 6	4 47	5 28	6 9	6 50	7 31	8 12	8 53	9 34	10 15
42	0 42	1 24	2 6	2 48	3 30	4 12	4 54	5 36	6 18	7 0	7 42	8 24	9 6	9 48	10 30
43	0 43	1 26	2 9	2 52	3 35	4 18	5 1	5 44	6 27	7 10	7 53	8 36	9 19	10 2	10 45
44	0 44	1 28	2 12	2 56	3 40	4 24	5 8	5 52	6 36	7 20	8 4	8 48	9 32	10 16	11 0
45	0 45	1 30	2 15	3 0	3 45	4 30	5 15	6 0	6 45	7 30	8 15	9 0	9 45	10 30	11 15
46	0 46	1 32	2 18	3 4	3 50	4 36	5 22	6 8	6 54	7 40	8 26	9 12	9 58	10 44	11 30
47	0 47	1 34	2 21	3 8	3 55	4 42	5 29	6 16	7 3	7 50	8 37	9 24	10 11	10 58	11 45
48	0 48	1 36	2 24	3 12	4 0	4 48	5 36	6 24	7 12	8 0	8 48	9 36	10 24	11 12	12 0
49	0 49	1 38	2 27	3 16	4 5	4 54	5 43	6 32	7 21	8 10	8 59	9 48	10 37	11 26	12 15
50	0 50	1 40	2 30	3 20	4 10	5 0	5 50	6 40	7 30	8 20	9 10	10 0	10 50	11 40	12 30
51	0 51	1 42	2 33	3 24	4 15	5 6	5 57	6 48	7 39	8 30	9 21	10 12	11 3	11 54	12 45
52	0 52	1 44	2 36	3 28	4 20	5 12	6 4	6 56	7 48	8 40	9 32	10 24	11 16	12 8	13 0
53	0 53	1 46	2 39	3 32	4 25	5 18	6 11	7 4	7 57	8 50	9 43	10 36	11 29	12 22	13 15
54	0 54	1 48	2 42	3 36	4 30	5 24	6 18	7 12	8 6	9 0	9 54	10 48	11 42	12 36	13 30
55	0 55	1 50	2 45	3 40	4 35	5 30	6 25	7 20	8 15	9 10	10 5	11 0	11 55	12 50	13 45
56	0 56	1 52	2 48	3 44	4 40	5 36	6 32	7 28	8 24	9 20	10 16	11 12	12 8	13 4	14 0
57	0 57	1 54	2 51	3 48	4 45	5 42	6 39	7 36	8 33	9 30	10 27	11 24	12 21	13 18	14 15
58	0 58	1 56	2 54	3 52	4 50	5 48	6 46	7 44	8 42	9 40	10 38	11 36	12 34	13 32	14 30
59	0 59	1 58	2 57	3 56	4 55	5 54	6 53	7 52	8 51	9 50	10 49	11 48	12 47	13 46	14 45
60	1 0	2 0	3 0	4 0	5 0	6 0	7 0	8 0	9 0	10 0	11 0	12 0	13 0	14 0	15 0

EXAMPLE. *To find the proportional Sexagesimal, correspondent to the Difference of* Argument 54′ 37″, *and Diff. of* Equation 14′ 13″?

By Table above 14′ 13″
by 54′ 37″

Product, the proportional Sexages. requ^d. 12′ 56″ 28‴ 1 iv.

For 54′ × 14′ =	12′	36″	‴	
13″ =	11	42		
37″ × 14′ =		8	38	iv
13″ =			8	1
	12	56	28	1

☞ *It may be here observed that the* ″ by ″ *(or 37″ by 13″) may be rejected as of small Value; for 60″ by 60″ = but 1″.*

SEXAGESIMAL TABLE *(continued)* for proportioning the DIFFERENCE of EQUATIONS at Sight; being the PRODUCT of Sexagesimals divided by 60.

″×″ / ′×″ / ′×′ / ″ ′	‴ iv / ″ ‴ / ′ ″ / 16	‴ iv / ″ ‴ / ′ ″ / 17	‴ iv / ″ ‴ / ′ ″ / 18	‴ iv / ″ ‴ / ′ ″ / 19	‴ iv / ″ ‴ / ′ ″ / 20	‴ iv / ″ ‴ / ′ ″ / 21	‴ iv / ″ ‴ / ′ ″ / 22	‴ iv / ″ ‴ / ′ ″ / 23	‴ iv / ″ ‴ / ′ ″ / 24	‴ iv / ″ ‴ / ′ ″ / 25	‴ iv / ″ ‴ / ′ ″ / 26	‴ iv / ″ ‴ / ′ ″ / 27	‴ iv / ″ ‴ / ′ ″ / 28	‴ iv / ″ ‴ / ′ ″ / 29	‴ iv / ″ ‴ / ′ ″ / 30
1	0 16	0 17	0 18	0 19	0 20	0 21	0 22	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 30
2	0 32	0 34	0 36	0 38	0 40	0 42	0 44	0 46	0 48	0 50	0 52	0 54	0 56	0 58	1 0
3	0 48	0 51	0 54	0 57	1 0	1 3	1 6	1 9	1 12	1 15	1 18	1 21	1 24	1 27	1 30
4	1 4	1 8	1 12	1 16	1 20	1 24	1 28	1 32	1 36	1 40	1 44	1 48	1 52	1 56	2 0
5	1 20	1 25	1 30	1 35	1 40	1 45	1 50	1 55	2 0	2 5	2 10	2 15	2 20	2 25	2 30
6	1 36	1 42	1 48	1 54	2 0	2 6	2 12	2 18	2 24	2 30	2 36	2 42	2 48	2 54	3 0
7	1 52	1 59	2 6	2 13	2 20	2 27	2 34	2 41	2 48	2 55	3 2	3 9	3 16	3 23	3 30
8	2 8	2 16	2 24	2 32	2 40	2 48	2 56	3 4	3 12	3 20	3 28	3 36	3 44	3 52	4 0
9	2 24	2 33	2 42	2 51	3 0	3 9	3 18	3 27	3 36	3 45	3 54	4 3	4 12	4 21	4 30
10	2 40	2 50	3 0	3 10	3 20	3 30	3 40	3 50	4 0	4 10	4 20	4 30	4 40	4 50	5 0
11	2 56	3 7	3 18	3 29	3 40	3 51	4 2	4 13	4 24	4 35	4 46	4 57	5 8	5 19	5 30
12	3 12	3 24	3 36	3 48	4 0	4 12	4 24	4 36	4 48	5 0	5 12	5 24	5 36	5 48	6 0
13	3 28	3 41	3 54	4 7	4 20	4 33	4 46	4 59	5 12	5 25	5 38	5 51	6 4	6 17	6 30
14	3 44	3 58	4 12	4 26	4 40	4 54	5 8	5 22	5 36	5 50	6 4	6 18	6 32	6 46	7 0
15	4 0	4 15	4 30	4 45	5 0	5 15	5 30	5 45	6 0	6 15	6 30	6 45	7 0	7 15	7 30
16	4 16	4 32	4 48	5 4	5 20	5 36	5 52	6 8	6 24	6 40	6 56	7 12	7 28	7 44	8 0
17	4 32	4 49	5 6	5 23	5 40	5 57	6 14	6 31	6 48	7 5	7 22	7 39	7 56	8 13	8 30
18	4 48	5 6	5 24	5 42	6 0	6 18	6 36	6 54	7 12	7 30	7 48	8 6	8 24	8 42	9 0
19	5 4	5 23	5 42	6 1	6 20	6 39	6 58	7 17	7 36	7 55	8 14	8 33	8 52	9 11	9 30
20	5 20	5 40	6 0	6 20	6 40	7 0	7 20	7 40	8 0	8 20	8 40	9 0	9 20	9 40	10 0
21	5 36	5 57	6 18	6 39	7 0	7 21	7 42	8 3	8 24	8 45	9 6	9 27	9 48	10 9	10 30
22	5 52	6 14	6 36	6 58	7 20	7 42	8 4	8 26	8 48	9 10	9 32	9 54	10 16	10 38	11 0
23	6 8	6 31	6 54	7 17	7 40	8 3	8 26	8 49	9 12	9 35	9 58	10 21	10 44	11 7	11 30
24	6 24	6 48	7 12	7 36	8 0	8 24	8 48	9 12	9 36	10 0	10 24	10 48	11 12	11 36	12 0
25	6 40	7 5	7 30	7 55	8 20	8 45	9 10	9 35	10 0	10 25	10 50	11 15	11 40	12 5	12 30
26	6 56	7 22	7 48	8 14	8 40	9 6	9 32	9 58	10 24	10 50	11 16	11 42	12 8	12 34	13 0
27	7 12	7 39	8 6	8 33	9 0	9 27	9 54	10 21	10 48	11 15	11 42	12 9	12 36	13 3	13 30
28	7 28	7 56	8 24	8 52	9 20	9 48	10 16	10 44	11 12	11 40	12 8	12 36	13 4	13 32	14 0
29	7 44	8 13	8 42	9 11	9 40	10 9	10 38	11 7	11 36	12 5	12 34	13 3	13 32	14 1	14 30
30	8 0	8 30	9 0	9 30	10 0	10 30	11 0	11 30	12 0	12 30	13 0	13 30	14 0	14 30	15 0
31	8 16	8 47	9 18	9 49	10 20	10 51	11 22	11 53	12 24	12 55	13 26	13 57	14 28	14 59	15 30
32	8 32	9 4	9 36	10 8	10 40	11 12	11 44	12 16	12 48	13 20	13 52	14 24	14 56	15 28	16 0
33	8 48	9 21	9 54	10 27	11 0	11 33	12 6	12 39	13 12	13 45	14 18	14 51	15 24	15 57	16 30
34	9 4	9 38	10 12	10 46	11 20	11 54	12 28	13 2	13 36	14 10	14 44	15 18	15 52	16 26	17 0
35	9 20	9 55	10 30	11 5	11 40	12 15	12 50	13 25	14 0	14 35	15 10	15 45	16 20	16 55	17 30
36	9 36	10 12	10 48	11 24	12 0	12 36	13 12	13 48	14 24	15 0	15 36	16 12	16 48	17 24	18 0
37	9 52	10 29	11 6	11 43	12 20	12 57	13 34	14 11	14 48	15 25	16 2	16 39	17 16	17 53	18 30
38	10 8	10 46	11 24	12 2	12 40	13 18	13 56	14 34	15 12	15 50	16 28	17 6	17 44	18 22	19 0
39	10 24	11 3	11 42	12 21	13 0	13 39	14 18	14 57	15 36	16 15	16 54	17 33	18 12	18 51	19 30
40	10 40	11 20	12 0	12 40	13 20	14 0	14 40	15 20	16 0	16 40	17 20	18 0	18 40	19 20	20 0
41	10 56	11 37	12 18	12 59	13 40	14 21	15 2	15 43	16 24	17 5	17 46	18 27	19 8	19 49	20 30
42	11 12	11 54	12 36	13 18	14 0	14 42	15 24	16 6	16 48	17 30	18 12	18 54	19 36	20 18	21 0
43	11 28	12 11	12 54	13 37	14 20	15 3	15 46	16 29	17 12	17 55	18 38	19 21	20 4	20 47	21 30
44	11 44	12 28	13 12	13 56	14 40	15 24	16 8	16 52	17 36	18 20	19 4	19 48	20 32	21 16	22 0
45	12 0	12 45	13 30	14 15	15 0	15 45	16 30	17 15	18 0	18 45	19 30	20 15	21 0	21 45	22 30
46	12 16	13 2	13 48	14 34	15 20	16 6	16 52	17 38	18 24	19 10	19 56	20 42	21 28	22 14	23 0
47	12 32	13 19	14 6	14 53	15 40	16 27	17 14	18 1	18 48	19 35	20 22	21 9	21 56	22 43	23 30
48	12 48	13 36	14 24	15 12	16 0	16 48	17 36	18 24	19 12	20 0	20 48	21 36	22 24	23 12	24 0
49	13 4	13 53	14 42	15 31	16 20	17 9	17 58	18 47	19 36	20 25	21 14	22 3	22 52	23 41	24 30
50	13 20	14 10	15 0	15 50	16 40	17 30	18 20	19 10	20 0	20 50	21 40	22 30	23 20	24 10	25 0
51	13 36	14 27	15 18	16 9	17 0	17 51	18 42	19 33	20 24	21 15	22 6	22 57	23 48	24 39	25 30
52	13 52	14 44	15 36	16 28	17 20	18 12	19 4	19 56	20 48	21 40	22 32	23 24	24 16	25 8	26 0
53	14 8	15 1	15 54	16 47	17 40	18 33	19 26	20 19	21 12	22 5	22 58	23 51	24 44	25 37	26 30
54	14 24	15 18	16 12	17 6	18 0	18 54	19 48	20 42	21 36	22 30	23 24	24 18	25 12	26 6	27 0
55	14 40	15 35	16 30	17 25	18 20	19 15	20 10	21 5	22 0	22 55	23 50	24 45	25 40	26 35	27 30
56	14 56	15 52	16 48	17 44	18 40	19 36	20 32	21 28	22 24	23 20	24 16	25 12	26 8	27 4	28 0
57	15 12	16 9	17 6	18 3	19 0	19 57	20 54	21 51	22 48	23 45	24 42	25 39	26 36	27 33	28 30
58	15 28	16 26	17 24	18 22	19 20	20 18	21 16	22 14	23 12	24 10	25 8	26 6	27 4	28 2	29 0
59	15 44	16 43	17 42	18 41	19 40	20 39	21 38	22 37	23 36	24 35	25 34	26 33	27 32	28 31	29 30
60	16 0	17 0	18 0	19 0	20 0	21 0	22 0	23 0	24 0	25 0	26 0	27 0	28 0	29 0	30 0

EXAMPLE II. Dif. Equat. 29′ 23″ }
By Dif. Arg. 51′ 41″ }

Product divided by 60 = 25′ 19″ Propor¹. Dif. required.

For, 51′ × 29′ = 24′ 39″ ‴
23″ = 19 33
41″ × 29′ = 19 49 iv
23″ = 15 43
} *According to the Table above.*

25′ 18″ 37‴ 43iv, accurately.

☞ *Hence, to find the proportional Sexagesimal true to Seconds, the* Fourths **may** *be rejected, or omitted, in the Computation, and as far as* Thirds *only retained.* — See further on.

SEXAGESIMAL TABLE (*continued*) for proportioning the DIFFERENCE of EQUATIONS at Sight; being the PRODUCT of Sexagesimals divided by 60.

‴×″ ″×″ ′×″ ′×′ ″ ′	‴ iv ″ ‴ ′ ″ 31	‴ iv ″ ‴ ′ ″ 32	‴ iv ″ ‴ ′ ″ 33	‴ iv ″ ‴ ′ ″ 34	‴ iv ″ ‴ ′ ″ 35	‴ iv ″ ‴ ′ ″ 36	‴ iv ″ ‴ ′ ″ 37	‴ iv ″ ‴ ′ ″ 38	‴ iv ″ ‴ ′ ″ 39	‴ iv ″ ‴ ′ ″ 40	‴ iv ″ ‴ ′ ″ 41	‴ iv ″ ‴ ′ ″ 42	‴ iv ″ ‴ ′ ″ 43	‴ iv ″ ‴ ′ ″ 44	‴ iv ″ ‴ ′ ″ 45
1	0 31	0 32	0 33	0 34	0 35	0 36	0 37	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 45
2	1 2	1 4	1 6	1 8	1 10	1 12	1 14	1 16	1 18	1 20	1 22	1 24	1 26	1 28	1 30
3	1 33	1 36	1 39	1 42	1 45	1 48	1 51	1 54	1 57	2 0	2 3	2 6	2 9	2 12	2 15
4	2 4	2 8	2 12	2 16	2 20	2 24	2 28	2 32	2 36	2 40	2 44	2 48	2 52	2 56	3 0
5	2 35	2 40	2 45	2 50	2 55	3 0	3 5	3 10	3 15	3 20	3 25	3 30	3 35	3 40	3 45
6	3 6	3 12	3 18	3 24	3 30	3 36	3 42	3 48	3 54	4 0	4 6	4 12	4 18	4 24	4 30
7	3 37	3 44	3 51	3 58	4 5	4 12	4 19	4 26	4 33	4 40	4 47	4 54	5 1	5 8	5 15
8	4 8	4 16	4 24	4 32	4 40	4 48	4 56	5 4	5 12	5 20	5 28	5 36	5 44	5 52	6 0
9	4 39	4 48	4 57	5 6	5 15	5 24	5 33	5 42	5 51	6 0	6 9	6 18	6 27	6 36	6 45
10	5 10	5 20	5 30	5 40	5 50	6 0	6 10	6 20	6 30	6 40	6 50	7 0	7 10	7 20	7 30
11	5 41	5 52	6 3	6 14	6 25	6 36	6 47	6 58	7 9	7 20	7 31	7 42	7 53	8 4	8 15
12	6 12	6 24	6 36	6 48	7 0	7 12	7 24	7 36	7 48	8 0	8 12	8 24	8 36	8 48	9 0
13	6 43	6 56	7 9	7 22	7 35	7 48	8 1	8 14	8 27	8 40	8 53	9 6	9 19	9 32	9 45
14	7 14	7 28	7 42	7 56	8 10	8 24	8 38	8 52	9 6	9 20	9 34	9 48	10 2	10 16	10 30
15	7 45	8 0	8 15	8 30	8 45	9 0	9 15	9 30	9 45	10 0	10 15	10 30	10 45	11 0	11 15
16	8 16	8 32	8 48	9 4	9 20	9 36	9 52	10 8	10 24	10 40	10 56	11 12	11 28	11 44	12 0
17	8 47	9 4	9 21	9 38	9 55	10 12	10 29	10 46	11 3	11 20	11 37	11 54	12 11	12 28	12 45
18	9 18	9 36	9 54	10 12	10 30	10 48	11 6	11 24	11 42	12 0	12 18	12 36	12 54	13 12	13 30
19	9 49	10 8	10 27	10 46	11 5	11 24	11 43	12 2	12 21	12 40	12 59	13 18	13 37	13 56	14 15
20	10 20	10 40	11 0	11 20	11 40	12 0	12 20	12 40	13 0	13 20	13 40	14 0	14 20	14 40	15 0
21	10 51	11 12	11 33	11 54	12 15	12 36	12 57	13 18	13 39	14 0	14 21	14 42	15 3	15 24	15 45
22	11 22	11 44	12 6	12 28	12 50	13 12	13 34	13 56	14 18	14 40	15 2	15 24	15 46	16 8	16 30
23	11 53	12 16	12 39	13 2	13 25	13 48	14 11	14 34	14 57	15 20	15 43	16 6	16 29	16 52	17 15
24	12 24	12 48	13 12	13 36	14 0	14 24	14 48	15 12	15 36	16 0	16 24	16 48	17 12	17 36	18 0
25	12 55	13 20	13 45	14 10	14 35	15 0	15 25	15 50	16 15	16 40	17 5	17 30	17 55	18 20	18 45
26	13 26	13 52	14 18	14 44	15 10	15 36	16 2	16 28	16 54	17 20	17 46	18 12	18 38	19 4	19 30
27	13 57	14 24	14 51	15 18	15 45	16 12	16 39	17 6	17 33	17 0	18 27	18 54	19 21	19 48	20 15
28	14 28	14 56	15 24	15 52	16 20	16 48	17 16	17 44	18 12	18 40	19 8	19 36	20 4	20 32	21 0
29	14 59	15 28	15 57	16 26	16 55	17 24	17 53	18 22	18 51	19 20	19 49	20 18	20 47	21 16	21 45
30	15 30	16 0	16 30	17 0	17 30	18 0	18 30	19 0	19 30	20 0	20 30	21 0	21 30	22 0	22 30
31	16 1	16 32	17 3	17 34	18 5	18 36	19 7	19 38	20 9	20 40	21 11	21 42	22 13	22 44	23 15
32	16 32	17 4	17 36	18 8	18 40	19 12	19 44	20 16	20 48	21 20	21 52	22 24	22 56	23 28	24 0
33	17 3	17 36	18 9	18 42	19 15	19 48	20 21	20 54	21 27	22 0	22 33	23 6	23 39	24 12	24 45
34	17 34	18 8	18 42	19 16	19 50	20 24	20 58	21 32	22 6	22 40	23 14	23 48	24 22	24 56	25 30
35	18 5	18 40	19 15	19 50	20 25	21 0	21 35	22 10	22 45	23 20	23 55	24 30	25 5	25 40	26 15
36	18 36	19 12	19 48	20 24	21 0	21 36	22 12	22 48	23 24	24 0	24 36	25 12	25 48	26 24	27 0
37	19 7	19 44	20 21	20 58	21 35	22 12	22 49	23 26	24 3	24 40	25 17	25 54	26 31	27 8	27 45
38	19 38	20 16	20 54	21 32	22 10	22 48	23 26	24 4	24 42	25 20	25 58	26 36	27 14	27 52	28 30
39	20 9	20 48	21 27	22 6	22 45	23 24	24 3	24 42	25 21	26 0	26 39	27 18	27 57	28 36	29 15
40	20 40	21 20	22 0	22 40	23 20	24 0	24 40	25 20	26 0	26 40	27 20	28 0	28 40	29 20	30 0
41	21 11	21 52	22 33	23 14	23 55	24 36	25 17	25 58	26 39	27 20	28 1	28 42	29 23	30 4	30 45
42	21 42	22 24	23 6	23 48	24 30	25 12	25 54	26 36	27 18	28 0	28 42	29 24	30 6	30 48	31 30
43	22 13	22 56	23 39	24 22	25 5	25 48	26 31	27 14	27 57	28 40	29 23	30 6	30 49	31 32	32 15
44	22 44	23 28	24 12	24 56	25 40	26 24	27 8	27 52	28 36	29 20	30 4	30 48	31 32	32 16	33 0
45	23 15	24 0	24 45	25 30	26 15	27 0	27 45	28 30	29 15	30 0	30 45	31 30	32 15	33 0	33 45
46	23 46	24 32	25 18	26 4	26 50	27 36	28 22	29 8	29 54	30 40	31 26	32 12	32 58	33 44	34 30
47	24 17	25 4	25 51	26 38	27 25	28 12	28 59	29 46	30 33	31 20	32 7	32 54	33 41	34 28	35 15
48	24 48	25 36	26 24	27 12	28 0	28 48	29 36	30 24	31 12	32 0	32 48	33 36	34 24	35 12	36 0
49	25 19	26 8	26 57	27 46	28 35	29 24	30 13	31 2	31 51	32 40	33 29	34 18	34 7	35 56	36 45
50	25 50	26 40	27 30	28 20	29 10	30 0	30 50	31 40	32 30	33 20	34 10	35 0	35 50	36 40	37 30
51	26 21	27 12	28 3	28 54	29 45	30 36	31 27	32 18	33 9	34 0	34 51	35 42	36 33	37 24	38 15
52	26 52	27 44	28 36	29 28	30 20	31 12	32 4	32 56	33 48	34 40	35 32	36 24	37 16	38 8	39 0
53	27 23	28 16	29 9	30 2	30 55	31 48	32 41	33 34	34 27	35 20	36 13	37 6	37 59	38 52	39 45
54	27 54	28 48	29 42	30 36	31 30	32 24	33 18	34 12	35 6	36 0	36 54	37 48	38 42	39 36	40 30
55	28 25	29 20	30 15	31 10	32 5	33 0	33 55	34 50	35 45	36 40	37 35	38 30	39 25	40 20	41 15
56	28 56	29 52	30 48	31 44	32 40	33 36	34 32	35 28	36 24	37 20	38 16	39 12	40 8	41 4	42 0
57	29 27	30 24	31 21	32 18	33 15	34 12	35 9	36 6	37 3	38 0	38 57	39 54	40 51	41 48	42 45
58	29 58	30 56	31 54	32 52	33 50	34 48	35 46	36 44	37 42	38 40	39 38	40 36	41 34	42 32	43 30
59	30 29	31 28	32 27	33 26	34 25	35 24	36 23	37 22	38 21	39 20	40 19	41 18	42 17	43 16	44 15
60	31 0	32 0	33 0	34 0	35 0	36 0	37 0	38 0	39 0	40 0	41 0	42 0	43 0	44 0	45 0

EXAMPLE III. Dif. Equat. 44′ 35″ } By Dif. Argument 43′ 47″ }

Product divided by 60 = 32′ 32″ required.

For, 43′ × 44′ = 31′ 32″ ‴
35″ = 25 5
47″ × 44′ = 34 28
33″ = 27

32′ 32″ 0 correctly to a *Third*.

According to the Table above.

SEXAGESIMAL TABLE *(continued)* for proportioning the DIFFERENCE of EQUATIONS at Sight: Being the PRODUCT of Sexagesimals divided by 60.

″×‴	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv	‴ iv
′×″	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴	″ ‴
′×′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
″ ′	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1	0 46	0 47	0 48	0 49	0 50	0 51	0 52	0 53	0 54	0 55	0 56	0 57	0 58	0 59	1 0
2	1 32	1 34	1 36	1 38	1 40	1 42	1 44	1 46	1 48	1 50	1 52	1 54	1 56	1 58	2 0
3	2 18	2 21	2 24	2 27	2 30	2 33	2 36	2 39	2 42	2 45	2 48	2 51	2 54	2 57	3 0
4	3 4	3 8	3 12	3 16	3 20	3 24	3 28	3 32	3 36	3 40	3 44	3 48	3 52	3 56	4 0
5	3 50	3 55	4 0	4 5	4 10	4 15	4 20	4 25	4 30	4 35	4 40	4 45	4 50	4 55	5 0
6	4 36	4 42	4 48	4 54	5 0	5 6	5 12	5 18	5 24	5 30	5 36	5 42	5 48	5 54	6 0
7	5 22	5 29	5 36	5 43	5 50	5 57	6 4	6 11	6 18	6 25	6 32	6 39	6 46	6 53	7 0
8	6 8	6 16	6 24	6 32	6 40	6 48	6 56	7 4	7 12	7 20	7 28	7 36	7 44	7 52	8 0
9	6 54	7 3	7 12	7 21	7 30	7 39	7 48	7 57	8 6	8 15	8 24	8 33	8 42	8 51	9 0
10	7 40	7 50	8 0	8 10	8 20	8 30	8 40	8 50	9 0	9 10	9 20	9 30	9 40	9 50	10 0
11	8 26	8 37	8 48	8 59	9 10	9 21	9 32	9 43	9 54	10 5	10 16	10 27	10 38	10 49	11 0
12	9 12	9 24	9 36	9 48	10 0	10 12	10 24	10 36	10 48	11 0	11 12	11 24	11 36	11 48	12 0
13	9 58	10 11	10 24	10 37	10 50	11 3	11 16	11 29	11 42	11 55	12 8	12 21	12 34	12 47	13 0
14	10 44	10 58	11 12	11 26	11 40	11 54	12 8	12 22	12 36	12 50	13 4	13 18	13 32	13 46	14 0
15	11 30	11 45	12 0	12 15	12 30	12 45	13 0	13 15	13 30	13 45	14 0	14 15	14 30	14 45	15 0
16	12 16	12 32	12 48	13 4	13 20	13 36	13 52	14 8	14 24	14 40	14 56	15 12	15 28	15 44	16 0
17	13 2	13 19	13 36	13 53	14 10	14 27	14 44	15 1	15 18	15 35	15 52	16 9	16 26	16 43	17 0
18	13 48	14 6	14 24	14 42	15 0	15 18	15 36	15 54	16 12	16 30	16 48	17 6	17 24	17 42	18 0
19	14 34	14 53	15 12	15 31	15 50	16 9	16 28	16 47	17 6	17 25	17 44	18 3	18 22	18 41	19 0
20	15 20	15 40	16 0	16 20	16 40	17 0	17 20	17 40	18 0	18 20	18 40	19 0	19 20	19 40	20 0
21	16 6	16 27	16 48	17 9	17 30	17 51	18 12	18 33	18 54	19 15	19 36	19 57	20 18	20 39	21 0
22	16 52	17 14	17 36	17 58	18 20	18 42	19 4	19 26	19 48	20 10	20 32	20 54	21 16	21 38	22 0
23	17 38	18 1	18 24	18 47	19 10	19 33	19 56	20 19	20 42	21 5	21 28	21 51	22 14	22 37	23 0
24	18 24	18 48	19 12	19 36	20 0	20 24	20 48	21 12	21 36	22 0	22 24	22 48	23 12	23 36	24 0
25	19 10	19 35	20 0	20 25	20 50	21 15	21 40	22 5	22 30	22 55	23 20	23 45	24 10	24 35	25 0
26	19 56	20 22	20 48	21 14	21 40	22 6	22 32	22 58	23 24	23 50	24 16	24 42	25 8	25 34	26 0
27	20 42	21 9	21 36	22 3	22 30	22 57	23 24	23 51	24 18	24 45	25 12	25 39	26 6	26 33	27 0
28	21 28	21 56	22 24	22 52	23 20	23 48	24 16	24 44	25 12	25 40	26 8	26 36	27 4	27 32	28 0
29	22 14	22 43	23 12	23 41	24 10	24 39	25 8	25 37	26 6	26 35	27 4	27 33	28 2	28 31	29 0
30	23 0	23 30	24 0	24 30	25 0	25 30	26 0	26 30	27 0	27 30	28 0	28 30	29 0	29 30	30 0
31	23 46	24 17	24 48	25 19	25 50	26 21	26 52	27 23	27 54	28 25	28 56	29 27	29 58	30 29	31 0
32	24 32	25 4	25 36	26 8	26 40	27 12	27 44	28 16	28 48	29 20	29 52	30 24	30 56	31 28	32 0
33	25 18	25 51	26 24	26 57	27 30	28 3	28 36	29 9	29 42	30 15	30 48	31 21	31 54	32 27	33 0
34	26 4	26 38	27 12	27 46	28 20	28 54	29 28	30 2	30 36	31 10	31 44	32 18	32 52	33 26	34 0
35	26 50	27 25	28 0	28 35	29 10	29 45	30 20	30 55	31 30	32 5	32 40	33 15	33 50	34 25	35 0
36	27 36	28 12	28 48	29 24	30 0	30 36	31 12	31 48	32 24	33 0	33 36	34 12	34 48	35 24	36 0
37	28 22	28 59	29 36	30 13	30 50	31 27	32 4	32 41	33 18	33 55	34 32	35 9	35 46	36 23	37 0
38	29 8	29 46	30 24	31 2	31 40	32 18	32 56	33 34	34 12	34 50	35 28	36 6	36 44	37 22	38 0
39	29 54	30 33	31 12	31 51	32 30	33 9	33 48	34 27	35 6	35 45	36 24	37 3	37 42	38 21	39 0
40	30 40	31 20	32 0	32 40	33 20	34 0	34 40	35 20	36 0	36 40	37 20	38 0	38 40	39 20	40 0
41	31 26	32 7	32 48	33 29	34 10	34 51	35 32	36 13	36 54	37 35	38 16	38 57	39 38	40 19	41 0
42	32 12	32 54	33 36	34 18	35 0	35 42	36 24	37 6	37 48	38 30	39 12	39 54	40 36	41 18	42 0
43	32 58	33 41	34 24	35 7	35 50	36 33	37 16	37 59	38 42	39 25	40 8	40 51	41 34	42 17	43 0
44	33 44	34 28	35 12	35 56	36 40	37 24	38 8	38 52	39 36	40 20	41 4	41 48	42 32	43 16	44 0
45	34 30	35 15	36 0	36 45	37 30	38 15	39 0	39 45	40 30	41 15	42 0	42 45	43 30	44 15	45 0
46	35 16	36 2	36 48	37 34	38 20	39 6	39 52	40 38	41 24	42 10	42 56	43 42	44 28	45 14	46 0
47	36 2	36 49	37 36	38 23	39 10	39 57	40 44	41 31	42 18	43 5	43 52	44 39	45 26	46 13	47 0
48	36 48	37 36	38 24	39 12	40 0	40 48	41 36	42 24	43 12	44 0	44 48	45 36	46 24	47 12	48 0
49	37 34	38 23	39 12	40 1	40 50	41 39	42 28	43 17	44 6	44 55	45 44	46 33	47 22	48 11	49 0
50	38 20	39 10	40 0	40 50	41 40	42 30	43 20	44 10	45 0	45 50	46 40	47 30	48 20	49 10	50 0
51	39 6	39 57	40 48	41 39	42 30	43 21	44 12	45 3	45 54	46 45	47 36	48 27	49 18	50 9	51 0
52	39 52	40 44	41 36	42 28	43 20	44 12	45 4	45 56	46 48	47 40	48 32	49 24	50 16	51 8	52 0
53	40 38	41 31	42 24	43 17	44 10	45 3	45 56	46 49	47 42	48 35	49 28	50 21	51 14	52 7	53 0
54	41 24	42 18	43 12	44 6	45 0	45 54	46 48	47 42	48 36	49 30	50 24	51 18	52 12	53 6	54 0
55	42 10	43 5	44 0	44 55	45-50	46 45	47 40	48 35	49 30	50 25	51 20	52 15	53 10	54 5	55 0
56	42 56	43 52	44 48	45 44	46 40	47 36	48 32	49 28	50 24	51 20	52 16	53 12	54 8	55 4	56 0
57	43 42	44 39	45 36	46 33	47 30	48 27	49 24	50 21	51 18	52 15	53 12	54 9	55 6	56 3	57 0
58	44 28	45 26	46 24	47 22	48 20	49 18	50 16	51 14	52 12	53 10	54 8	55 6	56 4	57 2	58 0
59	45 14	46 13	47 12	48 11	49 10	50 9	51 8	52 7	53 6	54 5	55 4	56 3	57 2	58 1	59 0
60	46 0	47 0	48 0	49 0	50 0	51 0	52 0	53 0	54 0	55 0	56 0	57 0	58 0	59 0	60 0

EXAMPLE IV. Dif. Equation $51' \; 57''$
By Dif. Argument $33' \; 49''$

Product divided by 60 = $29' \; 17''$ Proport^{l}. [Dif. requ^{d}.

For, $33' \times 51' = 28' \; 3'''$
$57'' = 31 \; 21$
$49'' \times 51' = 41 \; 39$
$57'' = 47$

$29' \; 16'' \; 47'''$

According to the Table above.

☞ The foregoing accurate *Sexagesimal* TABLES (of the greatest Use, for *Facility* of Computation) are a *new Invention*, never before published.

A TABLE of the VISIBLE ECLIPSES of the SUN, for 21 *Principal* CITIES of *EUROPE*.

CITIES NAMES.	1760. *June* 13, Morning. Begin-ning. h	m	Middle. h	m	End. h	m	Digits eclipſed. d	′
Amſterdam	7	1	7	42	8	42	4	48
Avignon	6	43	7	28	8	33	6	35
Berlin	7	35	8	31	9	28	5	24
Bologna in *It.*	7	10	8	4	9	10	7	41
Copenhagen	7	41	8	28	9	25	5	0
Cracow	7	55	8	46	9	59	6	56
Edinburgh	7	20	8	7	9	0	4	30
Geneva	6	58	7	48	8	54	7	0
Leipſic	7	31	8	19	9	22	5	50
Liſbon	5	41	6	24	7	18	6	27
London	6	41	7	14	8	17	4	10
Lyons	6	44	7	30	8	33	6	25
Madrid	6	3	6	48	7	47	6	24
Montpellier	6	40	7	26	8	30	6	12
Naples	7	15	8	14	9	22	9	0
Paris	6	43	7	28	8	26	5	21
Peterſburgh	9	4	9	57	11	0	5	55
Rome	7	9	8	6	9	13	8	21
Turin	6	55	7	46	8	49	6	48
Vienna	7	37	8	30	9	42	7	6
Upſal	8	10	9	2	9	54	4	58

CITIES NAMES.	1762. *October* 17, Morning. Begin-ning. h	m	Middle. h	m	End. h	m	Digits eclipſed. d	′
Amſterdam	7	8	8	14	9	14	6	0
Avignon	7	30	8	13	8	59	3	0
Berlin	7	44	8	52	9	59	7	4
Bologna in *It.*	7	52	8	45	9	41	4	33
Copenhagen	7	52	8	52	9	54	7	48
Cracow	8	24	9	28	10	31	6	40
Edinburgh	Set Ecl.		7	42	8	55	6	32
Geneva	7	39	8	25	9	23	4	5
Leipſic	7	51	8	50	9	54	6	45
Liſbon	7	0	Limb		of Moon		pourra mordre.	
London	6	59	7	50	8	48	5	20
Lyons	7	25	8	10	9	5	4	0
Madrid	7	4	7	28	8	3	1	0
Montpellier	7	26	8	10	8	53	3	0
Naples	8	11	9	9	0	56	3	40
Paris	7	12	8	3	8	56	4	42
Peterſburgh	9	9	10	17	11	28	10	45
Rome	8	0	8	44	9	44	3	40
Turin	7	35	8	23	9	20	4	8
Vienna	8	10	9	6	10	12	6	0
Upſal	8	15	9	18	10	26	9	38

CITIES NAMES.	1764. *April* 1, Forenoon. Begin-ning. h	m	Middle. h	m	End. h	m	Digits eclipſed. d	′
Amſterdam	9	43	11	8	0	43	11	1
Avignon	9	25	10	53	0	29	9	46
Berlin	10	14	11	52	1	32	10	3
Bologna in *It.*	9	59	11	31	1	5	8	52
Copenhagen	10	27	11	57	1	25	10	37
Cracow	10	56	0	26	1	56	8	34
Edinburgh	9	10	10	33	0	2	10	22
Geneva	9	44	11	15	0	50	9	19
Leipſic	10	17	11	48	1	19	9	57
Liſbon	9	57	11	26	1	3	7	30
London	9	16	10	43	0	15	Annular.	
Lyons	9	27	10	56	0	33	10	10
Madrid	8	32	10	1	11	36	10	53
Montpellier	9	17	10	47	0	24	10	3
Naples	10	10	11	44	1	16	7	44
Paris	9	$22\frac{1}{2}$	10	50	0	24	11	3
Peterſburgh	0	4	1	28	2	51	9	33
Rome	10	2	11	31	1	6	8	9
Turin	9	39	11	12	0	45	9	30
Vienna	10	36	0	1	1	38	8	39
Upſal	11	9	0	36	1	59	10	30

A TABLE of the VISIBLE ECLIPSES of the MOON, for *Greenwich* OBSERVATORY. And likewiſe the INVISIBLE ECLIPSES of SUN and MOON.

1760.
ECLIPSES 4.

Two of the Sun, and 2 of the Moon.

I. Of the *Moon, May* 29.
Beg. 9^h 13^m 37^s
Mid. 9 36 37
End 9 59 37
Duration 46 0
Night viſ. at Greenwich.
Quantity eclipſed 24′ of a Digit on the Southern Limb.

II. Of the *Sun*, (as above) *June* 13, in 1ſt Table.

III. Of the *Moon, Nov.* 22.
Beg. 7^h 55^m 16^s
Mid. 9 8 46
End 10 22 16
Dur. 2 27 0
Night viſ. at Greenwich.
Quantity eclipſed 6 Dig. 21′ on the Northern Part of the Moon.

IV. Of the *Sun, Dec.* 7. Middle 2^h 8^m Afternoon, inviſible in *Europe*, but viſible in *South America.*

1761.
ECLIPSES 4.

Two of the Sun, and 2 of the Moon.

I. Of the *Moon, May* 18.
Beg. 8^h 31^m 40^s
Imm. 9 38 22
Mi. 10 25 9
Em. 11 11 36
End 12 18 38
Dur. 3 46 58
Night. viſ. at Greenwich.
Quantity eclipſed 17^d 26′ on the North Part.

II. Of the *Sun, June* 3, viſible in *Lapland* and *Norway.*

III. Of the *Moon, Nov.* 12.
Beg. 10^h 0^m 3^s
Imm. 10 58 50
Mid. 11 47 57
Em. 11 51 26
End 1 35 51
Forenoon. Greenwich.
Quantity eclipſed 19^d 58′, viſible at *Japan* and *China.*

IV. Of the *Sun, Nov.* 26. viſible in the Southern Parts of the Globe, but not viſible in *Europe.*

1762.
ECLIPSES 4.

Two of the Sun, and 2 of the Moon.

I. Of the *Sun, April* 24, viſible in the Southern Parts of the Earth.

II. Of the *Moon, May* 8, viſible in the *Weſt Indies.*
Beg. 2^h 21^m 34^s
Mid. 3 53 54
End 5 26 14
Morn. Greenwich.
Quantity eclipſed 9^d 42′ on the Southern Part of the Moon.

III. Of the *Sun, Oct.* 17, viſible, as above, in the 1ſt Table.

IV. Of the *Moon, Nov.* 1, viſible, at *Greenwich.*
Beg. 7^h 22^m 26^s
Mid. 8 45 0
End 10 7 34
Night.
Quantity eclipſed 6^d 53′ on the Southern Part of the Moon.

1763.
ECLIPSES 2.

Two of the Sun only.

I. Of the *Sun, April* 13, viſible in *Africa*, and towards the extreme Southern Parts of *Europe.*

II. Of the *Sun, Oct.* 7, viſible in South *America*, and not viſible in *Europe.*

SEE

The RULES

OF

COMPUTATION

FURTHER ON.

1764.
ECLIPSES 4.

Two of the Sun, and 2 of the Moon.

I. Of the *Moon, March* 17.
Beg. 10^h 45^m 19^s
Mid. 12 8 42
End 1 32 5
Durat. 2 46 46
Night. viſ. at Greenwich.
Quantity eclipſed 8^d 31′ on the Southern Part of the Moon.

II. Of the *Sun, April* 1, viſible at *London*, as in Table above.

III. Of the *Moon, Sept.* 10, viſible in *America.*
Beg. 6^h 1^m 8^s
Mid. 7 12 33
End 8 23 58
Dur. 2 22 50
Morning. at Greenwich.
Quantity eclipſed 4^d 48′ on the Northern Part of the Moon.

IV. Of the *Sun, Sept.* 25, viſible only in the Southern Parts of the Earth.

A

A TABLE of the NEW, FULL and QUARTER MOONS for *Greenwich* OBSERVATORY, from Noon.

MONTHS.	Days.	1760. h	m		Days.	1761. h	m		Days.	1762. h	m		Days.	1763. h	m		Days.	1764. h	m	
JANUARY.	2	4	51	Full.	5	21	44	New.	3	0	35	Firſt Q.	6	5	29	Laſt Q.	2	22	2	New.
	9	17	56	Laſt Q.	13	14	12	Firſt Q.	9	21	57	Full.	13	14	49	New.	10	19	24	Firſt Q.
	17	18	32	New.	20	6	14	Full.	16	15	9	Laſt Q.	21	20	39	Firſt Q.	18	12	34	Full.
	24	19	11	Firſt Q.	27	11	26	Laſt Q.	24	16	11	New.	28	23	59	Full.	25	9	51	Laſt Q.
	31	18	24	Full.																
FEBRUARY.	8	15	20	Laſt Q.	4	15	39	New.	1	16	6	Firſt Q.	4	15	47	Laſt Q.	1	12	43	New.
	16	6	42	New.	11	23	58	Firſt Q.	8	8	3	Full.	12	10	15	New.	9	14	34	Firſt Q.
	23	3	17	Firſt Q.	18	17	47	Full.	15	6	50	Laſt Q.	20	13	49	Firſt Q.	17	1	16	Full.
					26	7	50	Laſt Q.	23	10	39	New.	27	10	20	Full.	23	18	11	Laſt Q.
MARCH.	1	9	17	Full.	6	6	59	New.	3	2	58	Firſt Q.	6	4	9	Laſt Q.	2	5	7	New.
	9	11	55	Laſt Q.	13	7	44	Firſt Q.	9	18	11	Full.	14	4	48	New.	10	9	43	Firſt Q.
	16	20	3	New.	20	6	13	Full.	17	0	30	Laſt Q.	22	3	43	Firſt Q.	17	12	3	Full.
	23	11	48	Firſt Q.	28	4	14	Laſt Q.	25	3	34	New.	28	19	30	Full.	24	3	28	Laſt Q.
	31	1	7	Full.													31	22	30	New.
APRIL.	8	5	35	Laſt Q.	4	19	31	New.	1	11	22	Firſt Q.	4	18	26	Laſt Q.	9	1	10	Firſt Q.
	15	5	11	New.	11	14	29	Firſt Q.	8	4	42	Full.	12	22	23	New.	15	22	38	Full.
	21	19	10	Firſt Q.	18	19	47	Full.	15	19	9	Laſt Q.	20	13	13	Firſt Q.	22	14	14	Laſt Q.
	29	17	27	Full.	26	22	37	Laſt Q.	23	17	33	New.	27	5	24	Full.	30	15	29	New.
									30	19	9	Firſt Q.								
MAY.	7	19	21	Laſt Q.	4	5	37	New.	7	16	0	Full.	4	12	24	Laſt Q.	8	12	47	Firſt Q.
	14	13	5	New.	10	21	1	Firſt Q.	15	13	17	Laſt Q.	12	13	23	New.	15	4	54	Full.
	21	7	56	Firſt Q.	18	10	23	Full.	23	4	42	New.	19	18	1	Firſt Q.	22	3	2	Laſt Q.
	29	9	26	Full.	26	14	0	Laſt Q.	29	22	23	Firſt Q.	26	13	40	Full.	30	6	53	New.
JUNE.	6	5	17	Laſt Q.	2	19	44	New.	6	4	19	Full.	3	3	12	Laſt Q.	6	21	13	Firſt Q.
	12	20	18	New.	9	6	6	Firſt Q.	14	5	56	Laſt Q.	11	1	25	New.	13	12	14	Full.
	19	20	33	Firſt Q.	17	1	14	Full.	21	13	18	New.	18	0	43	Firſt Q.	20	18	11	Laſt Q.
	28	0	19	Full.	25	2	26	Laſt Q.	28	4	3	Firſt Q.	24	23	23	Full.	28	20	18	New.
JULY.	5	12	16	Laſt Q.	1	20	31	New.	5	18	0	Full.	2	20	23	Laſt Q.	6	3	11	Firſt Q.
	12	3	53	New.	8	14	32	Firſt Q.	13	20	55	Laſt Q.	10	11	31	New.	12	20	15	Full.
	19	11	37	Firſt Q.	16	16	38	Full.	20	20	33	New.	17	5	37	Firſt Q.	20	10	27	Laſt Q.
	27	13	27	Full.	24	12	1	Laſt Q.	27	12	40	Firſt Q.	24	10	52	Full.	28	8	4	New.
					31	3	23	New.												
AUGUST.	3	17	50	Laſt Q.	7	3	26	Firſt Q.	4	8	11	Full.	1	13	17	Laſt Q.	4	8	7	Firſt Q.
	10	12	49	New.	15	7	18	Full.	12	9	43	Laſt Q.	8	20	3	New.	11	6	15	Full.
	18	4	37	Firſt Q.	22	19	57	Laſt Q.	19	2	33	New.	15	11	39	Firſt Q.	19	3	59	Laſt Q.
	26	1	32	Full.	29	11	17	New.	25	22	24	Firſt Q.	23	0	38	Full.	26	18	58	New.
													31	4	53	Laſt Q.				
SEPTEMBER.	1	23	18	Laſt Q.	5	19	43	Firſt Q.	3	0	5	Full.	7	4	19	New.	2	13	31	Firſt Q.
	8	23	50	New.	13	21	28	Full.	10	20	33	Laſt Q.	13	20	18	Firſt Q.	9	19	4	Full.
	16	23	24	Firſt Q.	21	2	48	Laſt Q.	17	11	33	New.	21	17	1	Full.	17	21	44	Laſt Q.
	24	12	21	Full.	27	21	24	New.	24	12	45	Firſt Q.	29	18	49	Laſt Q.	25	5	9	New.
OCTOBER.	1	5	56	Laſt Q.	5	14	43	Firſt Q.	2	16	30	Full.	6	13	2	New.	1	20	30	Firſt Q.
	8	14	0	New.	13	11	6	Full.	10	5	31	Laſt Q.	13	8	9	Firſt Q.	9	10	52	Full.
	16	18	12	Firſt Q.	20	9	32	Laſt Q.	16	21	14	New.	21	10	58	Full.	17	14	49	Laſt Q.
	23	22	46	Full.	27	10	31	New.	24	6	34	Firſt Q.	29	6	44	Laſt Q.	24	14	43	New.
	30	14	34	Laſt Q.													31	6	32	Firſt Q.
NOVEMBER.	7	7	2	New.	4	10	51	Firſt Q.	1	8	53	Full.	4	22	43	New.		6	32	Firſt Q.
	15	11	19	Firſt Q.	11	23	48	Full.	8	13	18	Laſt Q.	11	23	55	Firſt Q.	8	4	39	Full.
	22	9	24	Full.	18	17	3	Laſt Q.	15	9	18	New.	20	5	6	Full.	16	6	51	Laſt Q.
	29	1	59	Laſt Q.	26	2	35	New.	23	2	44	Firſt Q.	27	12	10	Laſt Q.	23	0	45	New.
									30	23	46	Full.					29	20	35	Firſt Q.
DECEMBER.	7	2	8	New.	4	6	32	Firſt Q.	7	20	53	Laſt Q.	4	9	32	New.	7	23	47	Full.
	15	2	13	Firſt Q.	11	11	20	Full.	14	23	35	New.	11	4	12	Firſt Q.	15	19	25	Laſt Q.
	21	19	27	Full.	18	2	33	Laſt Q.	23	9	12	Firſt Q.	19	21	15	Full.	22	10	57	New.
	28	17	0	Laſt Q.	25	20	54	New.	30	12	43	Full.	27	1	42	Laſt Q.	30	11	48	Firſt Q.

The USE *of Table, p.* 264. *To reduce the Moon's Place from* Greenwich *to* Antigua *Meridian* 60° W. *Diff. Longitude?*

	☽'s Pl. *Greenwich.*		By the *Table.*
Example. 1763 *Nov.* 1, Noon	13° ♍ 51′		Againſt 14° Diur. Dif. under 60° Dif. Long. W. . . . 2° 20′
2, Noon	28	36	45′ . . . . 7 30″
Diur. Dif.	14°	45′	

Equation of ☽'s Place . . + 2 27 30

1763 *Nov.* 1, Noon. ☽'s Place at *Greenwich* . . ♍ 13 51 0

☽'s Place at *Antigua*, requ^d. ♍ 16 18 30

N. B. *The ſame Method ſerves for* ☉'s *Declin. R. A. &c.*

The USE of Table, p. 264.

A TABLE of the *Semi-diurnal Arcs* of the SUN to every Degree of his Longitude in the *Ecliptic*, for *London*.

Argument. SUN's Longitude.

Lon. ☉	♋ 3s − +		♌ 4s − +		♍ 5s − +		♎ 6s − +		♏ 7s − +		♐ 8s − +		Lon. ☉
°	h	m	h	m	h	m	h	m	h	m	h	m	°
0	8	13	7	50	6	59	6	0	5	1	4	10	30
1	8	13	7	49	6	58	5	58	4	59	4	8	29
2	8	12	7	47	6	56	5	56	4	57	4	7	28
3	8	12	7	46	6	54	5	54	4	55	4	5	27
4	8	11	7	45	6	52	5	52	4	53	4	4	26
5	8	11	7	43	6	50	5	50	4	52	4	3	25
6	8	10	7	42	6	48	5	48	4	50	4	2	24
7	8	10	7	41	6	46	5	46	4	48	4	1	23
8	8	9	7	40	6	44	5	44	4	46	4	0	22
9	8	9	7	39	6	42	5	42	4	45	3	59	21
10	8	8	7	38	6	40	5	40	4	43	3	58	20
11	8	8	7	37	6	38	5	38	4	41	3	57	19
12	8	7	7	36	6	36	5	36	4	39	3	56	18
13	8	7	7	35	6	34	5	34	4	37	3	55	17
14	8	6	7	33	6	32	5	32	4	36	3	54	16
15	8	6	7	31	6	30	5	30	4	34	3	54	15
16	8	5	7	30	6	28	5	28	4	32	3	53	14
17	8	4	7	28	6	26	5	26	4	30	3	53	13
18	8	4	7	26	6	24	5	24	4	29	3	52	12
19	8	3	7	23	6	22	5	22	4	27	3	51	11
20	8	2	7	20	6	20	5	20	4	25	3	51	10
21	8	1	7	17	6	18	5	18	4	23	3	50	9
22	8	0	7	15	6	16	5	16	4	21	3	50	8
23	7	59	7	13	6	14	5	14	4	20	3	49	7
24	7	57	7	11	6	12	5	12	4	18	3	49	6
25	7	56	7	9	6	10	5	10	4	16	3	48	5
26	7	55	7	7	6	8	5	8	4	15	3	48	4
27	7	53	7	5	6	6	5	6	4	13	3	48	3
28	7	52	7	3	6	4	5	4	4	12	3	47	2
29	7	51	7	1	6	2	5	2	4	11	3	47	1
30	7	50	6	59	6	0	5	1	4	10	3	47	0
Lon. ☉	− + ♊ 2s		− + ♉ 1s		− + ♈ 0s		− + ♓ 11s		− + ♒ 10s		− + ♑ 9s		Lon. ☉

A TABLE of the *Semidiurnal Arcs* of the MOON to every Degree of her Longitude in the *Ecliptic*, at Southing, without Lat. for *London*.

Argument. MOON's Longitude.

This Table is a Correction of the Sun's Semi-diur. Arcs by mean Mot. ☽ à ☉.

Lon. ☽	♋ 3s − +		♌ 4s − +		♍ 5s − +		♎ 6s − +		♏ 7s − +		♐ 8s − +		Lon. ☽
°	h	m	h	m	h	m	h	m	h	m	h	m	°
0	8	29	8	6	7	13	6	12	5	11	4	18	30
1	8	29	8	5	7	12	6	10	5	9	4	16	29
2	8	28	8	3	7	10	6	8	5	7	4	15	28
3	8	28	8	2	7	8	6	6	5	5	4	13	27
4	8	27	8	1	7	6	6	4	5	3	4	12	26
5	8	27	7	59	7	4	6	2	5	2	4	11	25
6	8	26	7	58	7	2	6	0	5	0	4	10	24
7	8	26	7	57	7	0	5	58	4	58	4	9	23
8	8	25	7	56	6	58	5	56	4	56	4	8	22
9	8	25	7	55	6	56	5	54	4	55	4	7	21
10	8	24	7	54	6	54	5	52	4	53	4	6	20
11	8	24	7	53	6	52	5	50	4	51	4	5	19
12	8	23	7	52	6	50	5	48	4	49	4	4	18
13	8	23	7	51	6	48	5	46	4	47	4	3	17
14	8	22	7	49	6	46	5	44	4	46	4	2	16
15	8	22	7	47	6	43	5	42	4	44	4	2	15
16	8	21	7	45	6	41	5	39	4	42	4	1	14
17	8	20	7	43	6	39	5	37	4	40	4	1	13
18	8	20	7	41	6	37	5	35	4	38	4	0	12
19	8	19	7	38	6	35	5	33	4	36	3	59	11
20	8	18	7	35	6	33	5	31	4	34	3	59	10
21	8	17	7	31	6	31	5	29	4	32	3	58	9
22	8	16	7	29	6	29	5	27	4	50	3	58	8
23	8	15	7	27	6	26	5	24	4	29	3	57	7
24	8	13	7	25	6	24	5	22	4	27	3	57	6
25	8	12	7	23	6	22	5	20	4	25	3	56	5
26	8	11	7	21	6	20	5	18	4	23	3	56	4
27	8	9	7	19	6	18	5	16	4	21	3	56	3
28	8	8	7	17	6	16	5	14	4	20	3	55	2
29	8	7	7	15	6	14	5	12	4	19	3	55	1
30	8	6	7	13	6	12	5	11	4	18	3	55	0
Lon. ☽	− + ♊ 2s		− + ♉ 1s		− + ♈ 0s		− + ♓ 11s		− + ♒ 10s		− + ♑ 0s		Lon. ☽

A TABLE shewing, by the MOON's *Age*, the *near* Time of her *Rising* and *Setting*, in *England* and *Ireland*, when she is in the *Beginning*, *Middle*, or *End* of each Sign in the Ecliptic (*supposing her to have no Lat.*) her mean *Place* and *Age* being known, at Sight, by *Tab. p.* 151, 152.

☽ Age.	♋ 3s Mid.	End Be.	♌ 4s Mid.	End Be.	♍ 5s Mid.	End Be.	♎ 6s Mid.	End. Beg.	♏ 7s Mid.	End. Beg	♐ 8s Mid.	End.
	8h 22m	8h 6m	7h 47m	7h 13m	6h 43m	6h 12m	5h 42m	5h 11m	4h 44m	4h 18m	4h 2m	3h 55m
	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.	Sets.
1	9 A 10	8 54	8 A 35	8 A 1	7 A 31	7 A 0	6 A 30	5 A 59	5 A 32	5 A 6	4 A 50	4 A 43
2	9 58	9 42	9 23	8 49	8 19	7 48	7 18	6 47	6 20	5 54	5 38	5 31
3	10 46	10 30	10 11	9 37	9 7	8 36	8 6	7 35	7 8	6 42	6 26	6 19
4	11 34	11 18	10 59	10 25	9 55	9 24	8 54	8 23	7 56	7 30	7 14	7 7
5	0 M 22	0 M 6	11 47	11 13	10 43	10 12	9 42	9 11	8 44	8 18	8 2	7 55
6	1 10	0 54	0 M 35	0 M 1	11 31	11 0	10 30	9 59	9 32	9 6	8 50	8 43
7	1 58	1 42	1 23	0 49	0 M 19	11 48	11 18	10 47	10 20	9 54	9 38	9 31
8	2 46	2 30	2 11	1 37	1 7	0 M 36	0 M 6	11 35	11 8	10 42	10 26	10 19
9	3 34	3 18	2 59	2 25	1 55	1 24	0 54	0 M 23	11 56	11 30	11 14	11 7
10	4 22	4 6	3 47	3 13	2 43	2 12	1 42	1 11	0 M 44	0 M 18	0 M 2	11 55
11	5 10	4 54	4 35	4 1	3 31	3 0	2 30	1 59	1 32	1 6	0 50	0 M 43
12	5 58	5 42	5 23	4 49	4 19	3 48	3 18	2 47	2 20	1 54	1 38	1 31
13	6 46	6 30	6 11	5 37	5 7	4 36	4 6	3 35	3 8	2 42	2 26	2 19
14	7 34	7 18	6 59	6 25	5 55	5 24	4 54	4 23	3 56	3 30	3 14	3 7
	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.	Rises.
15	3 A 38	3 A 54	4 A 13	4 A 47	5 A 17	5 A 48	6 A 18	6 A 49	7 A 16	7 A 42	7 A 52	8 A 5
16	4 26	4 42	5 1	5 35	6 5	6 36	7 6	7 37	8 4	8 30	8 40	8 53
17	5 14	5 30	5 49	6 23	6 53	7 24	7 54	8 25	8 52	9 18	9 28	9 41
18	6 2	6 18	6 37	7 11	7 41	8 12	8 42	9 13	9 40	10 26	10 16	10 29
19	6 50	7 6	7 25	7 59	8 29	9 0	9 30	10 1	10 28	10 54	11 4	11 17
20	7 38	7 54	8 13	8 47	9 17	9 48	10 18	10 49	11 16	11 42	11 52	0 M 5
21	8 26	8 42	9 1	9 35	10 5	10 36	11 6	11 37	0 M 4	0 M 30	0 M 40	0 53
22	9 14	9 30	9 49	10 23	10 53	11 24	11 54	0 M 25	0 52	1 18	1 28	1 41
23	10 2	10 18	10 37	11 11	11 41	0 M 10	0 M 42	1 13	1 40	2 6	2 16	2 29
24	10 50	11 6	11 25	11 59	0 M 29	1 0	1 30	2 1	2 28	2 54	3 4	3 17
25	11 38	11 54	0 M 13	0 M 47	1 17	1 48	2 18	2 49	3 16	3 42	3 52	4 5
26	0 M 26	0 M 42	1 1	1 35	2 5	2 36	3 6	3 37	4 4	4 30	4 40	4 53
27	1 14	1 30	1 49	2 23	2 53	3 24	3 54	4 25	4 52	5 58	5 28	5 41
28	2 2	2 18	2 37	3 11	3 41	4 12	4 40	5 13	5 40	6 26	6 16	6 29
29	2 50	3 6	3 25	3 59	4 29	5 0	5 30	6 1	6 28	6 54	7 4	7 17
30	3 38	3 54	4 13	4 47	5 17	5 48	6 18	6 49	7 16	7 42	7 52	8 5
☽ A	Mid. ♊ 2s	Be. End	Mid. ♉ 1s	Be. End	Mid. ♈ 0s	Be. End	Mid. ♓ 11s	Beg. End.	Mid. ♒ 10s	Beg. End.	Mid. ♑ 9s	Beg.

EQUATION of the true Horizontal DIAMETER of the MOON to the apparent Horizontal DIAMETER, in Parts of the EQUATOR.

Argument. MOON's DECLINATION.

True Horizontal Diameter of the Moon.

Dec. of ☽	29′ 30″ +		30′ 0″ +		30′ 30″ +		31′ 0″ +		31′ 30″ +		32′ 0″ +		32′ 30″ +		33′ 0″ +		33′ 30″ +		34′ 0″ +	
°	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
3	0	2	0	2	0	2	9	2	0	2	0	3	0	3	0	3	0	3	0	3
4	0	4	0	4	0	4	0	4	0	4	0	5	0	5	0	5	0	5	0	5
5	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7	0	7
6	0	10	0	10	0	10	0	10	0	10	0	11	0	11	0	11	0	11	0	11
7	0	13	0	13	0	13	0	14	0	14	0	14	0	15	0	15	0	15	0	15
8	0	17	0	17	0	17	0	18	0	18	0	18	0	19	0	19	0	20	0	20
9	0	21	0	22	0	22	0	23	0	23	0	23	0	24	0	24	0	25	0	25
10	0	27	0	27	0	28	0	28	0	29	0	29	0	30	0	30	0	31	0	31
11	0	33	0	33	0	34	0	34	0	35	0	36	0	37	0	37	0	38	0	38
12	0	40	0	40	0	41	0	42	0	42	0	43	9	44	0	44	0	45	0	46
13	0	47	0	47	0	48	0	49	0	50	0	51	0	52	0	52	0	53	0	54
14	0	54	0	55	0	56	0	57	0	58	0	59	1	0	1	1	1	2	1	3
15	1	2	1	3	1	4	1	5	1	7	1	8	1	9	1	10	1	11	1	12
16	1	11	1	12	1	13	1	14	1	16	1	17	1	19	1	20	1	21	1	22
17	1	21	1	22	1	23	1	24	1	26	1	27	1	29	1	31	1	32	1	33
18	1	31	1	32	1	34	1	35	1	37	1	38	1	40	1	42	1	43	1	45
19	1	42	1	43	1	45	1	47	1	49	1	50	1	52	1	54	1	56	1	58
20	1	54	1	55	1	57	1	59	2	1	2	3	2	5	2	7	2	9	2	11
21	2	6	2	8	2	10	2	12	2	14	2	17	2	19	2	21	2	23	2	25
22	2	19	2	21	2	24	2	26	2	28	2	31	2	33	2	35	2	38	2	40
23	2	33	2	35	2	38	2	41	2	43	2	46	2	48	2	51	2	54	2	56
24	2	47	2	50	2	53	2	56	2	59	3	1	3	4	3	7	3	10	3	13
25	3	2	3	5	3	9	3	12	3	15	3	18	3	21	3	25	3	28	3	31
26	3	18	3	22	3	25	3	29	3	32	3	36	3	40	3	44	3	47	3	50
27	3	36	3	40	3	43	3	47	3	51	3	55	3	59	4	3	4	6	4	10
28	3	55	3	59	4	3	4	7	4	11	4	15	4	19	4	23	4	27	4	31
29	4	14	4	19	4	23	4	27	4	31	4	36	4	40	4	44	4	49	4	53
30	4	34	4	39	4	43	4	48	4	52	4	57	5	1	5	6	5	11	5	16

Equation of the true Diameter of ☽ to the ap. Diam. in Alt.

Argument. ☽'s Altitude.

☽'s Alt.	Moon in Apog. +	Moon in Perig. +
°	″	″
0	0	0
3	2	2
6	3	4
9	5	6
12	6	7
15	8	9
18	9	11
21	10	12
24	11	15
27	12	16
30	14	18
33	15	19
36	16	21
39	18	23
42	19	24
45	20	25
48	21	27
51	22	28
54	23	29
57	23	30
60	24	31
63	25	32
66	26	33
69	26	34
72	27	34
75	27	35
78	27	35
81	28	36
84	28	36
87	28	36
90	29	36

Equat. or Reduct. of *Paris* to *Greenwich* Places.

Argument. Differences.

Dif.	Equat. ±		Dif.	Equat. ±	
″ / ′ / °	‴ / ″ / ′	iv / ‴ / ″	″ / ′ / °	‴ / ″ / ′	iv / ‴ / ″
1	0	23	31	12	3
2	0	47	32	12	27
3	1	10	33	12	50
4	1	33	34	13	13
5	1	56	35	13	37
6	2	20	36	14	0
7	2	43	37	14	23
8	3	7	38	14	47
9	3	30	39	15	10
10	3	53	40	15	33
11	4	17	41	15	57
12	4	40	42	16	20
13	5	3	43	16	43
14	5	27	44	17	7
15	5	50	45	17	30
16	6	13	46	17	53
17	6	37	47	18	17
18	7	0	48	18	40
19	7	23	49	19	3
20	7	47	50	19	27
21	8	10	51	19	50
22	8	33	52	20	13
23	8	57	53	20	37
24	9	20	54	21	0
25	9	53	55	21	13
26	10	7	56	21	47
27	10	30	57	22	10
28	10	53	58	22	33
29	11	16	59	22	57
30	11	40	60	23	20

CONSTRUCTION.

To find the Equation to 30′ true ~~*Semi*~~*Diam. of the Moon in Parts of the Equator?*

	As Cos. Declination	30°	co. 0.0624694
	To Radius	S. 90	10.0000000
So for the Rest.	So *true* Horiz. Diam. ☽ . . .	30′	7.9408419
	To *Apparent* Diameter	34 39″	8.0033113
	Diff. The Equation	+ 4′ 39″ required.	

NEXT, To find the Time of the Moon's Passage thro' the Meridian? *As* 360° *is to* ☽'*s apparent horizontal Diam. in Parts of the Equator, so is the* Interval *of Time betwixt the Moon's two next Passages thro' the same Meridian, (or Dif. of th. Sun and Moon's R. A. in Time, for 24 Hours) to the Time of the Moon's Passage thro' that Meridian.*

EXAMPLE. *To find the Time of the Moon's Passage thro' the Meridian, December 30, 1764, at Greenwich?*

☽'s Declination 30 *Dec.* at Noon, 7° 31′ N. True Horiz. Parallax then, 54′ 21″

For Horiz. Parall. 21 *Dec.* 56′ 52″   1′ 7″ } True Hor. Parallax at passing the Merid. } 54 16

26 . . . 55 28

Dif. in 5 Days   1 24 : 4ᵈ : 1′ 7″ } ☽'s Horiz. Diameter correspondent. } 29 15

☽ Passes Merid. *Greenwich* 30 *Dec.* 1674 | 6ʰ 18ᵐ } Equation . . + 0 15

31 . . | 6 59 } ☽ app. Hor. Diam. 29 30

Now, As 360° to 29′ 30″, So 24ʰ 41ᵐ to 2ᵐ 1ˢ, Time of ☽ passing the Meridian required.

N. B. De La Caille's *Ephem. has true Horiz. Diam.* 29′ 23″ }
Time of ☽'*s Passage thro' the Meridian* . . . . 2ᵐ 2ˢ }

☞ The Moon's Horizontal Parallax to ☽'s Horiz. Diameter is 55′ 40″ to 30′

N. B. The above small Table is similar to *that* at p. 215, here recited for Use.

☽ tr. Hor. Diam. 29′ 15″
Equation + 0 15

☽'s apparent Hor. Diam. } 29 30

☽'s Altitude 46° 2′ *Greenwich* }

Equation at a Means . } + 0 22

☽'s ap. Diam. in Altitude. } 29 52

Correspondent to which, in first Tab. p. 29, answers 1ᵐ 59ˢ

Answerable to which ☽ mean Mot. } 1 5

Sum 30 57

In Time, by Tab. p. 29. } 2ᵐ 3ˢ

Or 360° : 29′ 52″ : : 24ʰ 41ᵐ : 2ᵐ 3ˢ as before.

EXAMPLE I.

		☽'s Place.
1764, *Aug.* 9, Noon		18° ♑ 29′
At *Paris* 10 . .		2 ♒ 17
	Dif.	13 48

To reduce the ☽'*s Places to* Greenwich *for those Days.*

Argument. 13° + 5′ 3″
48′ + 0 19

Sum, Equation + 5 22

Noon { *Aug.* 9 | 18° ♑ 34′
      { 10 | 2 ♒ 22

☽'s Places at *Greenwich*, requ.

EXAMPLE II.

		☽'s Declination.
Noon	1763, *Oct.* 4	12° 44′ N
	At *Paris* 5	5 58 N
	Dif.	6 46

To reduce these Declinations to Greenwich?

Argument. 6° — 2′ 20″
46′ — 0 18

Sum, Equation — 2 38

Noon { *Oct.* 4 | 12 41 N
      { 5 | 5 55 N

At *Greenwich*, required.

N. B. *The Moon's semi-diurnal Arc, as in 2d Table of the left Hand Page, is added to or subtracted from the mean Time of her Southing, according to her Age, for her Setting and Rising, as at Bottom of the left Hand Page, in the 3d Table.*

A TABLE shewing the PROPORTIONAL DIFFERENCE to be *added* or *subtracted* to or from the SUN, MOON, or PLANET's *Place, Declination, R. A. &c.* at a *first* Meridian for the *respective Place, Declination, R. A. &c.* to a given *Difference* of *West* or *East* Longitude.

Arguments. Diurnal Difference more or less; and Difference of Longitude.

Diurn. Diff.	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −	+ −
''	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv	'' ''' iv
'	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''	' '' '''
°	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''	° ' ''
1	0 1 40	0 3 20	0 5 0	0 6 40	0 8 20	0 10 0	0 11 40	0 13 20	0 15 0	0 16 40	0 18 20	0 20 0
2	0 3 20	0 6 40	0 10 0	0 13 20	0 16 40	0 20 0	0 23 20	0 26 40	0 30 0	0 33 20	0 36 40	0 40 0
3	0 5 0	0 10 0	0 15 0	0 20 0	0 25 0	0 30 0	0 35 0	0 40 0	0 45 0	0 50 0	0 55 0	1 0 0
4	0 6 40	0 13 20	0 20 0	0 26 40	0 33 20	0 40 0	0 46 40	0 53 20	1 0 0	1 6 40	1 13 20	1 20 0
5	0 8 20	0 16 40	0 25 0	0 33 20	0 41 40	0 50 0	0 58 20	1 6 40	1 15 0	1 23 20	1 31 40	1 40 0
6	0 10 0	0 20 0	0 30 0	0 40 0	0 50 0	1 0 0	1 10 0	1 20 0	1 30 0	1 40 0	1 50 0	2 0 0
7	0 11 40	0 23 20	0 35 0	0 46 40	0 58 20	1 10 0	1 21 40	1 33 20	1 45 0	1 56 40	2 8 20	2 20 0
8	0 13 20	0 26 40	0 40 0	0 53 20	1 6 40	1 20 0	1 33 20	1 46 40	2 0 0	2 12 20	2 26 40	2 40 0
9	0 15 0	0 30 0	0 45 0	1 0 0	1 15 0	1 30 0	1 45 0	2 0 0	2 15 0	2 30 0	2 45 0	3 0 0
10	0 16 40	0 33 20	0 50 0	1 6 40	1 23 20	1 40 0	1 56 40	2 13 20	2 30 0	2 46 40	3 3 20	3 20 0
11	0 18 20	0 36 40	0 55 0	1 13 20	1 31 40	1 50 0	2 8 20	2 26 40	2 45 0	3 3 20	3 21 40	3 40 0
12	0 20 0	0 40 0	1 0 0	1 20 0	1 40 0	2 0 0	2 20 0	2 40 0	3 0 0	3 20 0	3 40 0	4 0 0
13	0 21 40	0 43 20	1 5 0	1 26 40	1 48 20	2 10 0	2 31 40	2 53 20	3 15 0	3 36 40	3 58 20	4 20 0
14	0 23 20	0 46 40	1 10 0	1 33 20	1 56 40	2 20 0	2 43 20	3 6 40	3 30 0	3 53 20	4 16 40	4 40 0
15	0 25 0	0 51 0	1 15 0	1 40 0	2 5 0	2 30 0	2 55 0	3 20 0	3 45 0	4 10 0	4 35 0	5 0 0
16	0 26 40	0 54 20	1 20 0	1 46 40	2 13 20	2 40 0	3 6 40	3 33 20	4 0 0	4 26 40	4 53 20	5 20 0
17	0 28 20	0 57 40	1 25 0	1 53 20	2 21 40	2 50 0	3 18 20	3 46 40	4 15 0	4 43 20	5 11 40	5 40 0
18	0 30 0	1 0 0	1 30 0	1 0 0	2 30 0	3 0 0	3 30 0	4 0 0	4 30 0	5 0 0	5 30 0	6 0 0
19	0 31 40	1 3 20	1 35 0	2 6 40	2 38 20	3 10 0	3 41 40	4 13 20	4 45 0	5 16 40	5 48 20	6 20 0
20	0 33 20	1 6 40	1 40 0	2 13 20	2 46 40	3 20 0	3 53 20	4 26 40	5 0 0	5 33 20	6 6 40	6 40 0
21	0 35 0	1 10 0	1 45 0	2 20 0	2 55 0	3 30 0	4 5 0	4 40 0	5 15 0	5 50 0	6 25 0	7 0 0
22	0 36 40	1 13 20	1 50 0	2 26 40	3 3 20	3 40 0	4 16 40	4 53 20	5 30 0	6 6 40	6 43 20	7 20 0
23	0 38 20	1 16 40	1 55 0	2 33 20	3 11 40	3 50 0	4 28 20	5 6 40	5 45 0	6 23 20	7 1 40	7 40 0
24	0 40 0	1 20 0	2 0 0	2 40 0	3 20 0	4 0 0	4 40 0	5 20 0	6 0 0	6 40 0	7 20 0	8 0 0
25	0 41 40	1 23 20	2 5 0	2 46 40	3 28 20	4 10 0	4 51 40	5 33 20	6 15 0	6 56 40	7 38 20	8 20 0
26	0 43 20	1 26 40	2 10 0	2 53 20	3 36 40	4 20 0	5 3 20	5 46 40	6 30 0	7 13 20	7 56 40	8 40 0
27	0 45 0	1 30 0	2 15 0	3 0 0	3 45 0	4 30 0	5 15 0	6 0 0	6 45 0	7 30 0	8 15 0	9 0 0
28	0 46 40	1 33 20	2 20 0	3 6 40	3 53 20	4 40 0	5 26 40	6 13 20	7 0 0	7 46 40	8 33 20	9 20 0
29	0 48 20	1 36 40	2 25 0	3 13 20	4 1 40	4 50 0	5 38 20	6 26 40	7 15 0	8 3 20	8 51 40	9 40 0
30	0 50 0	1 40 0	2 30 0	3 20 0	4 10 0	5 0 0	5 50 0	6 40 0	7 30 0	8 20 0	9 10 0	10 0 0
31	0 51 40	1 43 20	2 35 0	3 26 40	4 18 20	5 10 0	6 1 40	6 53 20	7 45 0	8 36 40	9 28 20	10 20 0
32	0 53 20	1 46 40	2 40 0	3 33 20	4 26 40	5 20 0	6 13 20	7 6 40	8 0 0	8 53 20	9 46 40	10 40 0
33	0 55 0	1 50 0	2 45 0	3 40 0	4 35 0	5 30 0	6 25 0	7 20 0	8 15 0	9 10 0	10 5 0	11 0 0
34	0 56 40	1 53 20	2 50 0	3 46 40	4 43 20	5 40 0	6 36 40	7 33 20	8 30 0	9 26 40	10 23 20	11 20 0
35	0 58 20	1 56 40	2 55 0	3 53 20	4 51 40	5 50 0	6 48 20	7 46 40	8 45 0	9 43 20	10 41 40	11 40 0
36	1 0 0	2 0 0	3 0 0	4 0 0	5 0 0	6 0 0	7 0 0	8 0 0	9 0 0	10 0 0	11 0 0	12 0 0
37	1 1 40	2 3 20	3 5 0	4 6 40	5 8 20	6 10 0	7 11 40	8 13 20	9 15 0	10 16 40	11 18 20	12 20 0
38	1 3 20	2 6 40	3 10 0	4 13 20	5 16 40	6 20 0	7 23 20	8 26 40	9 30 0	10 33 20	11 36 40	12 40 0
39	1 5 0	2 10 0	3 15 0	4 20 0	5 25 0	6 30 0	7 35 0	8 40 0	9 45 0	10 50 0	11 55 0	13 0 0
40	1 6 40	2 13 20	3 20 0	4 26 40	5 33 20	6 40 0	7 46 40	8 53 20	10 0 0	11 6 40	12 13 20	13 20 0
41	1 8 20	2 16 40	3 25 0	4 33 20	5 41 40	6 50 0	7 58 20	9 6 40	10 15 0	11 23 20	12 31 40	13 40 0
42	1 10 0	2 20 0	3 30 0	4 40 0	5 50 0	7 0 0	8 10 0	9 20 0	10 30 0	11 40 0	12 50 0	14 0 0
43	1 11 40	2 23 20	3 35 0	4 46 40	5 58 20	7 10 0	8 21 40	9 33 20	10 45 0	11 56 40	13 8 20	14 20 0
44	1 13 20	2 26 40	3 40 0	4 53 20	6 6 40	7 20 0	8 33 20	9 46 40	11 0 0	12 13 20	13 26 40	14 40 0
45	1 15 0	2 30 0	3 45 0	5 0 0	6 15 0	7 30 0	8 45 0	10 0 0	11 15 0	12 30 0	13 45 0	15 0 0
46	1 16 40	2 33 20	3 50 0	5 6 40	6 23 20	7 40 0	8 56 40	10 13 20	11 30 0	12 46 40	14 3 20	15 20 0
47	1 18 20	2 36 40	3 55 0	5 13 20	6 31 40	7 50 0	9 8 20	10 26 40	11 45 0	13 3 20	14 21 40	15 40 0
48	1 20 0	2 40 0	4 0 0	5 20 0	6 40 0	8 0 0	9 20 0	10 40 0	12 0 0	13 20 0	14 40 0	16 0 0
49	1 21 40	2 43 20	4 5 0	5 26 40	6 48 20	8 10 0	9 31 40	10 53 20	12 15 0	13 36 40	14 58 20	16 20 0
50	1 23 20	2 46 40	4 10 0	5 33 20	6 56 40	8 20 0	9 43 20	11 6 40	12 30 0	13 53 20	15 16 40	16 40 0
51	1 25 0	2 50 0	4 15 0	5 40 0	6 5 0	8 30 0	9 55 0	11 20 0	12 45 0	14 10 0	15 35 0	17 0 0
52	1 26 40	2 53 20	4 20 0	5 46 40	6 13 20	8 40 0	10 6 40	11 33 20	13 0 0	14 26 40	15 53 20	17 20 0
53	1 28 20	2 56 40	4 25 0	5 53 20	6 21 40	8 50 0	10 18 20	11 46 40	13 15 0	14 43 20	16 11 40	17 40 0
54	1 30 0	3 0 0	4 30 0	6 0 0	6 30 0	9 0 0	10 30 0	12 0 0	13 30 0	15 0 0	16 30 0	18 0 0
55	1 31 40	3 3 20	4 35 0	6 6 40	6 38 20	9 10 0	10 41 40	12 13 20	13 45 0	15 16 40	16 48 20	18 20 0
56	1 33 20	3 6 40	4 40 0	6 13 20	6 46 40	9 20 0	10 53 20	12 26 40	14 0 0	15 33 20	17 6 40	18 40 0
57	1 35 0	3 10 0	4 45 0	6 20 0	7 55 0	9 30 0	11 5 0	12 40 0	14 15 0	15 50 0	17 25 0	19 0 0
58	1 36 40	3 13 20	4 50 0	6 26 40	8 3 20	9 40 0	11 16 40	12 53 20	14 30 0	16 6 40	17 43 20	19 20 0
59	1 38 20	3 16 40	4 55 0	6 33 20	8 11 40	9 50 0	11 28 20	13 6 40	14 45 0	16 23 20	18 1 40	19 40 0
60	1 40 0	3 20 0	5 0 0	6 40 0	8 20 0	10 0 0	11 40 0	13 20 0	15 0 0	16 40 0	18 20 0	20 0 0

CONSTRUCTION. As 360° to any *diurnal* Difference, so 10°, 20°, 30°, *&c.* Dif. Long. to the proportional Dif. to be *added* to or *subtracted* from the Quantity for the 1st Meridian, according as the Quantity for 2d Day is more or less than the Quantity for the 1st Meridian, the Longitude being *West* of 1st Meridian. Which proportional Difference is to be subtracted instead of added, or added instead of subtracted, when the Difference of Longitude is easterly from the 1st Meridian. *See Bottom of p. 261 for Exam. here not being Room.*

EQUATION of the DIFFERENCE of *Right Afcenfions*, in Time, at Noon, between the SUN, MOON, PLANETS, and STARS, to the nearer Time of their refpective Southing at *Greenwich*.

Dif. R. A. at Noon.	*Argument.* Difference of the Sun's R. A. in Time, at Noon, from the R. A. in Time of the Moon, a Planet or Star, at Noon.						
	☽	♄	♃	♂	♀	☿	*
	+	—	—	—	+	+	—
h	h m s	m s	m s	m s	m s	m s	m s
m	m s th	s th	s th	s th	s th	s th	s th
s	s th fo	th fo	th fo	th fo	th fo	th fo	th fo
1	0 2 2	0 10	0 9	0 5	0 6	0 31	0 10
2	0 4 4	0 19	0 18	0 9	0 12	1 2	0 20
3	0 6 6	0 29	0 27	0 14	0 18	1 33	0 30
4	0 8 8	0 38	0 36	0 18	0 25	2 4	0 39
5	0 10 10	0 49	0 45	0 23	0 31	2 35	0 49
6	0 12 11	0 57	0 54	0 28	0 37	3 6	0 59
7	0 14 13	1 7	1 3	0 32	0 43	3 38	1 9
8	0 16 15	1 16	1 12	0 37	0 49	4 9	1 19
9	0 18 17	1 26	1 21	0 42	0 55	4 40	1 29
10	0 20 19	1 35	1 30	0 46	1 2	5 11	1 39
11	0 22 21	1 45	1 39	0 51	1 8	5 42	1 49
12	0 24 23	1 54	1 48	0 55	1 14	6 13	1 58
13	0 26 25	2 4	1 58	1 0	1 20	6 44	2 8
14	0 28 27	2 14	2 7	1 5	1 26	7 15	2 18
15	0 30 29	2 23	2 16	1 9	1 32	7 46	2 28
16	0 32 31	2 33	2 25	1 14	1 39	8 17	2 38
17	0 34 32	2 42	2 34	1 19	1 45	8 48	2 48
18	0 36 34	2 52	2 43	1 23	1 51	9 19	2 58
19	0 38 36	3 1	2 52	1 28	1 57	9 51	3 8
20	0 40 38	3 10	3 1	1 32	2 3	10 22	3 17
21	0 42 40	3 20	3 10	1 37	2 9	10 53	3 27
22	0 44 42	3 29	3 19	1 42	2 16	11 24	3 37
23	0 46 44	3 39	3 28	1 46	2 22	11 55	3 47
24	0 48 46	3 49	3 37	1 51	2 28	12 26	3 57
25	0 50 48	3 59	3 46	1 56	2 34	12 57	4 7
26	0 52 50	4 8	3 55	2 0	2 40	13 28	4 17
27	0 54 51	4 18	4 4	2 5	2 46	13 59	4 27
28	0 56 53	4 27	4 13	2 9	2 53	14 30	4 36
29	0 58 55	4 38	4 22	2 14	2 59	15 1	4 46
30	1 0 57	4 46	4 31	2 19	3 5	15 32	4 56
31	1 2 59	4 56	4 40	2 23	3 11	16 4	5 6
32	1 5 2	5 5	4 49	2 28	3 17	16 35	5 16
33	1 7 3	5 15	4 58	2 33	3 23	17 6	5 26
34	1 9 5	5 24	5 7	2 37	3 30	17 37	5 35
35	1 11 7	5 34	5 16	2 42	3 36	18 8	5 45
36	1 13 8	5 43	5 25	2 46	3 42	18 39	5 55
37	1 15 10	5 53	5 35	2 51	3 48	19 10	6 5
38	1 17 12	6 3	5 44	2 56	3 54	19 41	6 15
39	1 19 14	6 12	5 53	3 0	4 0	20 12	6 25
40	1 21 16	6 22	6 2	3 5	4 7	20 43	6 35
41	1 23 18	6 31	6 11	3 10	4 13	21 14	6 45
42	1 25 20	6 41	6 20	3 14	4 19	21 45	6 54
43	1 27 22	6 50	6 29	3 19	4 25	22 17	7 4
44	1 29 24	6 59	6 38	3 23	4 31	22 48	7 14
45	1 31 26	7 9	6 47	3 28	4 37	23 19	7 24
46	1 33 28	7 18	6 56	3 33	4 44	23 50	7 34
47	1 35 29	7 28	7 5	3 37	4 50	24 21	7 44
48	1 37 32	7 38	7 14	3 42	4 56	24 52	7 54
49	1 39 4	7 48	7 23	3 47	5 2	25 23	8 4
50	1 41 6	7 57	7 32	3 51	5 8	25 54	8 13
51	1 43 8	8 7	7 41	3 56	5 14	26 25	8 23
52	1 45 10	8 16	7 50	4 0	5 21	26 56	8 33
53	1 47 12	8 27	7 59	4 5	5 27	27 27	8 43
54	1 49 14	8 35	8 8	4 10	5 33	27 58	8 53
55	1 51 16	8 45	8 17	4 14	5 39	28 30	9 3
56	1 53 17	8 54	8 26	4 19	5 45	29 1	9 13
57	1 55 19	9 4	8 35	4 24	5 51	29 32	9 23
58	1 57 21	9 13	8 44	4 28	5 58	29 43	9 32
59	1 59 23	9 23	8 53	4 33	6 4	30 34	9 42
60	2 1 25	9 32	9 2	4 37	6 10	31 5	9 52

N. B. *The above* Table *alfo finds the Dif. of Time to be added to or fubtracted from the Time of Southing at the firft Meridian, for the Time of Southing at any Place of given* Eaft *or* Weft *Longitude, refpectively, the Sun's being the fwifter Motion; but Dif. of Time to be fubtracted and added for* Eaft *and* Weft *Long. in Time, the Sun's being the flower Motion; add for Southing of* ☽, ♀, *and* ☿; *and fub. for* ♄, ♃, ♂, *and* *'s *Southing, Long.* W; *and the* contrary *Long.* E. *The Equation being taken from the Hours, Minutes, and Seconds, Difference of Longitude,* Eaft *or* Weft *from the firft Meridian.*

CONSTRUCTION of the adjacent TABLE.

	M. Diurnal Motion.				*D. Mot. Time.*		
☽ à ☉	12°	11′	26″	41‴	48ᵐ	46ˢ	Taken as the mean Differences of R. A. of thofe Bodies for 24 Hours refpectively.
☉ à ♄	0	57	7	46	3	49	
☉ à ♃	0	54	9	2	3	37	
☉ à ♂	0	27	41	40	1	51	
♀ à ☉	0	36	59	29	2	28	
☿ à ☉	3	6	24	14	12	26	
☉ à *	0	59	8	10	3	57	

From which *diurnal* Differences of mean Motion, in Time, taken as mean Differences of right Afcenfion, the Quantities of *Equation* to the firft Time of near Southing, is refpectively proportioned, in the feveral adjacent Columns.

RULE. *Thefe Equations add to or fubtract from the Time of near Southing, at* Greenwich, *for the nearer Tim there, according as the Motion of the cœleftial Body (marked at the Head of each Column) is fwifter or flower than the Sun's Motion, refpectively.*

EXAMPLE I. *To find the nearer Time of the Moon's Southing, from the Difference of right Afcenfior of the Sun, from right Afcenfion of the Moon, at Noon, being given?*

		h	m	s
By p. 238. ☽ R. A. — ☉ R. A. 1762, *July* 10, Noon, *Greenwich* . .		15	16	3
By *Table* on the Left 15ʰ . . . . *Equation*	+		30	29
16ᵐ . . . . *Equation*	+		0	33
☽'s nearer Time of Southing at *Greenwich*, 1762, *July* 10, P. M. . . .		15	47	5

Being an Improvement on Mr. BRENT'S METHOD.

Correct Time of ☽'s *Southing*, P. M. at *Greenwich*, by the fame Page 238 . .	15	41	18
Error . . —		5ᵐ	47ˢ

☞ This METHOD of finding the near Time of the Moon's Southing never differs from the Truth but in a *few Minutes*. As the fame Method finds the Southing of the Stars within a *few Seconds* of Time; and alfo the Southing of all the Planets fcarcely differing a Minute from Truth.

EXAMPLE II. *To find the nearer Time of* Aldebaran's *Southing from the Difference of right Afcenfion of the Sun from right Afcenfion of* Aldebaran, *at Noon, being given?*

		h	m	s
By p. 218. R. A. of *Aldebaran* — R. A. of ☉ or + Com. R. A. ☉. 1760, *Dec.* 30, Noon . . .		9	41	25
By *Tab.* on the Left 9ʰ . . . *Equation*	—		1	29
41ᵐ . . . *Equation*	—		0	7
Total Equation	—		1	36
Rem. Near Time Southing of *Aldebaran* 1760, *Dec.* 30, at *Greenwich*, P. M.		9	39	49
Correct Time of *Aldebaran*'s Southing, by fame Page 218		9	39	38
Error	—			11ˢ
Antigua 4ʰ Weft Long. . . . Equation correfpondent to *Aldeb.* Southing at *Greenwich*.	—			39ˢ
Aldebaran nearly fouths at *Antigua* . . .		9	39	10
Correctly fouths at *Antigua*, by p. 218 . . .		9	38	54
☞ *The fame Method holds good for the Planets.* *Error*	+			16ˢ only.

HERE FOLLOW

LOGISTICAL LOGARITHMS.

The NATURE and USE of LOGISTICAL LOGARITHMS.

THE *Difference between the common Logarithm of* 3600″ (being the Seconds in a Degree) *and the common Logarithm of any other Number of Seconds, under or above* 3600, *is called the* Logiſtical Logarithm *of that Number of Seconds. These logiſtical Logarithms begin at* 60′, *and increaſe negatively under and affirmatively above* 60′.

The principal Uſe of theſe *logiſtical Logarithms* is for the ready proportioning *Sexageſimal* Quantities of all Kinds; and eſpecially thoſe in the *Ratio* of 1 Degree Increaſe of Argument to a given Increaſe or Decreaſe of Equation, correſpondent: though they have all the Uſe of common Logarithms as far as the Number of Seconds in the *following Table* (p. 267) extend.

The DETERMINATION *and* USE *of the logiſtical Logarithms from the common* LOGARITHMS.

EXAMPLE I. *To find the Equation of the* SUN's *Center for* 1s 6° 27′ 38″ *mean Anomaly of the* Sun?

Argument.	Equat. ☉'s Cent.		Com. Log.	Same Com. Logs.	Lo. Log.	extra	
1s 6°	1° 6′ 57″	As 60′ 0″=3600″	3.5563025	As 1 = L. 1	0.0000	000	As 60′ 0″
1 7	1 8 33						
Incr. 1°	Incr. 1′ 36″	To +1 36 = 96	1.9822712	To $\frac{96}{3600}$ = L. 96—L.3600	—1.5740	313	To 1 36
		So 27 38 =1658	3.2195845				
		To +0 44 = 44	1.6455532	So $\frac{1658}{3600}$ = L. 1658—L.3600	—0.3367	180	So 27 38
	First Equation 1° 6′ 57						
	Equation of Sun's Center 1° 7′ 41″ reqd.			To $\frac{44}{3600}$ = L. 44—L.3600	—1.9107 *	493	To 0 44

EXAMPLE II. *To find the* SUN's *Right Aſcenſion anſwerable to the Sun's Place* ♐ 27° 37′ 41″?

Argument.	R. A. Sun.		Com. Log.	Same Com. Logs.	Lo. Log.	extra	As
♐ 27°	266° 43′ 47″	As 60′ 0″=3600″	3.5563025	As 1 . . . L. 1	0.0000	000	60′ 0″
28	267 49 11						
Incr. 1°	Inc. 1 5 24	To 65 24 =3924	3.5937290	To $\frac{3924}{3600}$ = L. 3924—L.3600, co.	—9.9625	735	65 24
		So 37 41 =2261	3.3543006				
		To 41 4 =2464	3.3917271	So $\frac{2261}{3600}$ = L. 2261—L.3600	—0.2020	019	37 41
	First Equation 266° 43 47						
	R. A. Sun 267 24 51 reqd.			To $\frac{2464}{3600}$ = L. 2464—L.3600	—0.1645 *	754	41 4

By the above *two Operations* it appears, that the *logiſtical Logarithms*, for all *Sexageſimals*, under 60′, come out * *negative*; and all logiſtical Logarithms for Sexageſimals above 60′ come out *affirmative*, or with contrary Signs to one another. So that if the logiſtical Logarithms for Quantities under 60′ be conſidered *affirmative* (as they are conſidered in the logiſtical Tables in *general*) the logiſtical Logarithms for Quantities above 60′ muſt be conſidered as *negative*; and therefore we have given their arithmetical *Complement*, to make them correſpond with the logiſtical Logarithms for Quantities under 60′; only in taking them out, you muſt remember to prefix the Index + 9 or $\bar{1}$ to all logiſtical Logarithms for Numbers above 60′; the *Indices* for all Numbers under 60′ being given in the following Table; *viz.* below 60′, down to 6′, the *Index* is 0; and below 6′ down to 1″, the *Indices* are either 1, 2, or 3, as expreſſed. So *that you have Nothing to do but uſe the logiſtical Tables like the common Tables of Logarithms, in taking out the Logarithms to the Numbers, and finding the Number correſpondent to any Logarithm.*

TO find the logiſtical Logarithm of any Number of Degrees and Minutes, not exceeding 90°, *or of Minutes and Seconds, not above* 90′, *or of any Number not exceeding* 5400?

AT the Top, or Bottom of the *Table* find the Degrees or Minutes, and in the ſame Column againſt the Minutes or Seconds, reſpectively, on the Side of the Page, you will find the logiſtical Logarithm, required. — In the *ſecond Row*, acroſs the Page, from the Top, find the Number next leſs than the Number given, and in the ſame Column, againſt the *Difference* greater than that Number, to make up the Number ſought, on the Side of the Page, you will find the *logiſtical Logarithm* thereof, required.

When two of the given Terms are greater than 5400, take their *Halves, Thirds, &c.* being in the ſame Ratio. — But if only one of the given *Terms* exceed 5400, take its *Half, Third, &c.* and multiply the 4th Term reſulting, by 2, 3, *&c.* to correſpond with the given *Ratio*.

If *Hours* are in the Terms of the Proportion, their logiſtical Logarithms may be taken out of the Table as *Minutes*, and the logiſtical Logarithm to the Minutes of an Hour may be taken out as for Seconds.

The *log. Logarithms* of two ſmall Arcs (being nearly as their *Sines* or *Tangents*) may be uſed in trigonometrical Proportions, with the common Log. *Sines*, or *Tangents*, of two of the other Terms, being large Arcs; but then inſtead of the Log. *Sines* or *Tangents* of thoſe large Arcs you muſt take their arithmetical Complements, and the *contrary*; becauſe *(properly)* the logiſtical Logarithms in *our Table* are all *negative*, (but being all of one Kind are conſidered affirmative) and ſo in uſing them with *affirmative common Logarithms* the latter muſt be reduced to *Negatives*. Or elſe our *negative* logiſtical Logarithms muſt be reduced to *Affirmatives*, (like common Logarithms) by taking their arithmetical Complements, when they are uſed with *common Logarithms*, without taking their arithmetical Complements. But this Proportion may be as ſpeedily reſolved by common Logarithm *Sines* to every Second of ſmall Arcs (ſerving indifferently for Log. Tangents of thoſe Arcs) with the Log. Sines or Tangents of large Arcs.

EXAMPLES.

	Lo. Log.		L. Log.		Lo. Log.		Lo. Log.		Lo. Log.
As 60′ 0″	0.0000	As 70° 19′ co.	0.0689	As 24h co.	$\bar{1}$.6021	As 1h 0′ co.	8.2218	As 4721 co.	0.1177
To 75 18	$\bar{1}$.9014	To 34 50	0.2362	To 76′ 34″	$\bar{1}$.8941	To 13′ 7″	0.6603	To 60′ . . .	0.0000
So 76 11	$\bar{1}$.8963	So 29 31	0.3081	So 13h 53m	0.6357	So 6° 19′	0.9777	So 2948	0.0868
To 95 36	$\bar{1}$.7977	To 14 37	0.6132	To 44′ 17″	0.1319	To 82′ 52″	9.8598	To 37′ 28″	0.2045

	Lo. Log.		Lo. Log.		Com. L. Sines		Lo. Log.		Lo. Log.	
Or, As 60′ 0″	0.0000	As 15′ 37″ co.	$\bar{1}$.4154	As S. 20′ 35″ co.	2.2227608	As 20′ 35″ co.	$\bar{1}$.5354	As 20′ 35″	$\bar{0}$.4646	contrarily.
To 75 18	$\bar{1}$.9014	To 8h 7′	0.8688	To S. 14′ 27″	7.6235927	To 14′ 27″	0.6183	To 14.27 co	$\bar{1}$.3817	
So ½ or 38 5½	0.1973	So 46′ 11″	0.1137	So S. 37° 19′	9.7826301	So S. 37° 19′ co.	0.2173	So S. 37° 19′	9.7826	Log. Sines.
To ½ or 47 48	0.0987	To 24h 0	0.3979	To S. 25° 11′	9.6289836	To S. 25° 11′ co.	0.3710	To S. 25 11	9.6289	
Doub. 95 36 as above.						S.	9.6290			

LOGISTICAL

LOGISTICAL LOGARITHMS.

° ′	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	° ′
′ ″	0	60	120	180	240	300	360	420	480	540	600	660	720	780	840	′ ″
0		1.7782	1.4771	1.3010	1.1761	1.0792	0000	9331	8751	8239	7782	7368	6990	6642	6320	0
1	3.5563	1.7710	1.4735	1.2986	1.1743	1.0777	9988	9320	8742	8231	7774	7361	6984	6637	6315	1
2	3.2553	1.7639	1.4699	1.2962	1.1725	1.0763	9976	9310	8733	8223	7767	7354	6978	6631	6310	2
3	3.0792	1.7570	1.4664	1.2939	1.1707	1.0749	9964	9300	8724	8215	7760	7348	6972	6625	6305	3
4	2.9542	1.7501	1.4629	1.2915	1.1689	1.0734	9952	9289	8715	8207	7753	7341	6966	6620	6300	4
5	2.8573	1.7434	1.4594	1.2891	1.1671	1.0720	9940	9279	8706	8199	7745	7335	6960	6614	6294	5
6	2.7782	1.7368	1.4559	1.2868	1.1654	1.0706	9928	9269	8697	8191	7738	7328	6954	6609	6289	6
7	2.7112	1.7302	1.4525	1.2845	1.1636	1.0692	9916	9259	8688	8183	7731	7322	6948	6603	6284	7
8	2.6532	1.7238	1.4491	1.2821	1.1619	1.0678	9905	9249	8679	8175	7724	7315	6942	6598	6279	8
9	2.0621	1.7175	1.4457	1.2798	1.1601	1.0663	9893	9238	8670	8167	7717	7309	6936	6592	6274	9
10	2.5563	1.7112	1.4424	1.2775	1.1584	1.0649	9881	9228	8661	8159	7710	7302	6930	6587	6269	10
11	2.5149	1.7050	1.4390	1.2753	1.1566	1.0635	9869	9218	8652	8152	7703	7296	6924	6581	6264	11
12	2.4771	1.6990	1.4357	1.2730	1.1549	1.0621	9858	9208	8643	8144	7696	7289	6918	6576	6259	12
13	2.4424	1.6930	1.4325	1.2707	1.1532	1.0608	9846	9198	8635	8136	7688	7283	6912	6570	6254	13
14	2.4102	1.6871	1.4292	1.2685	1.1515	1.0594	9834	9188	8626	8128	7681	7276	6906	6565	6248	14
15	2.3802	1.6812	1.4260	1.2663	1.1498	1.0580	9823	9178	8617	8120	7674	7270	6900	6559	6243	15
16	2.3522	1.6755	1.4228	1.2640	1.1481	1.0566	9811	9168	8608	8112	7669	7264	6894	6554	6238	16
17	2.3259	1.6698	1.4196	1.2618	1.1464	1.0552	9800	9158	8599	8104	7660	7257	6888	6548	6233	17
18	2.3010	1.6642	1.4165	1.2596	1.1447	1.0539	9788	9148	8591	8097	7653	7251	6882	6543	6228	18
19	2.2775	1.6587	1.4133	1.2574	1.1430	1.0525	9777	9138	8582	8089	7646	7244	6877	6538	6223	19
20	2.2553	1.6532	1.4102	1.2553	1.1413	1.0512	9765	9128	8573	8081	7639	7238	6871	6532	6218	20
21	2.2341	1.6478	1.4071	1.2531	1.1397	1.0498	9754	9119	8565	8073	7632	7232	6865	6527	6213	21
22	2.2139	1.6425	1.4040	1.2510	1.1380	1.0484	9742	9109	8556	8066	7625	7225	6859	6521	6208	22
23	2.1946	1.6372	1.4010	1.2488	1.1363	1.0471	9731	9099	8547	8058	7618	7219	6853	6516	6203	23
24	2.1761	1.6320	1.3979	1.2467	1.1347	1.0458	9720	9089	8539	8050	7611	7212	6847	6510	6198	24
25	2.1584	1.6269	1.3949	1.2445	1.1331	1.0444	9708	9079	8530	8043	7604	7206	6841	6505	6193	25
26	2.1413	1.6218	1.3919	1.2424	1.1314	1.0431	9697	9070	8522	8035	7597	7200	6836	6500	6188	26
27	2.1249	1.6168	1.3890	1.2403	1.1298	1.0418	9686	9060	8513	8027	7590	7193	6830	6494	6183	27
28	2.1091	1.6118	1.3860	1.2382	1.1282	1.0404	9675	9050	8504	8020	7583	7187	6824	6489	6178	28
29	2.0939	1.6069	1.3831	1.2362	1.1266	1.0391	9664	9041	8496	8012	7577	7181	6818	6484	6173	29
30	2.0792	1.6021	1.3802	1.2341	1.1249	1.0378	9652	9031	8487	8004	7570	7175	6812	6478	6168	30
31	2.0649	1.5973	1.3773	1.2320	1.1233	1.0365	9641	9021	8479	7997	7563	7168	6807	6473	6163	31
32	2.0512	1.5925	1.3745	1.2300	1.1217	1.0352	9630	9012	8470	7989	7556	7162	6801	6467	6158	32
33	2.0378	1.5878	1.3716	1.2279	1.1201	1.0339	9619	9002	8462	7981	7549	7156	6795	6462	6153	33
34	2.0248	1.5832	1.3688	1.2259	1.1186	1.0326	9608	8992	8453	7974	7542	7149	6789	6457	6148	34
35	2.0122	1.5786	1.3660	1.2239	1.1170	1.0313	9597	8983	8445	7966	7535	7143	6784	6451	6143	35
36	2.0000	1.5740	1.3632	1.2218	1.1154	1.0300	9586	8973	8437	7959	7528	7137	6778	6446	6138	36
37	1.9881	1.5695	1.3604	1.2198	1.1138	1.0287	9575	8964	8428	7951	7522	7131	6772	6441	6133	37
38	1.9765	1.5651	1.3576	1.2178	1.1123	1.0274	9564	8954	8420	7944	7515	7124	6766	6435	6128	38
39	1.9652	1.5607	1.3549	1.2159	1.1107	1.0261	9553	8945	8411	7936	7508	7118	6761	6430	6123	39
40	1.9542	1.5563	1.3522	1.2139	1.1091	1.0248	9542	8935	8403	7929	7501	7112	6755	6425	6118	40
41	1.9435	1.5520	1.3495	1.2119	1.1076	1.0235	9532	8926	8395	7921	7494	7106	6749	6420	6113	41
42	1.9331	1.5477	1.3468	1.2099	1.1061	1.0223	9521	8917	8386	7914	7488	7100	6743	6414	6108	42
43	1.9228	1.5435	1.3441	1.2080	1.1045	1.0210	9510	8907	8378	7906	7481	7093	6738	6409	6103	43
44	1.9128	1.5393	1.3415	1.2061	1.1030	1.0197	9499	8898	8370	7899	7474	7087	6732	6404	6099	44
45	1.9031	1.5351	1.3388	1.2041	1.1015	1.0185	9488	8888	8361	7891	7467	7081	6726	6398	6094	45
46	1.8935	1.5310	1.3362	1.2022	1.0999	1.0172	9478	8879	8353	7884	7461	7075	6721	6393	6089	46
47	1.8842	1.5269	1.3336	1.2003	1.0984	1.0160	9467	8870	8345	7877	7454	7069	6715	6388	6084	47
48	1.8751	1.5229	1.3310	1.1984	1.0969	1.0147	9456	8861	8337	7869	7447	7063	6709	6383	6079	48
49	1.8661	1.5189	1.3284	1.1965	1.0954	1.0135	9446	8851	8328	7862	7441	7057	6704	6377	6074	49
50	1.8573	1.5149	1.3259	1.1946	1.0939	1.0122	9435	8842	8320	7855	7434	7050	6698	6372	6069	50
51	1.8487	1.5110	1.3233	1.1927	1.0924	1.0110	9425	8823	8312	7847	7427	7044	6692	6367	6064	51
52	1.8403	1.5071	1.3208	1.1908	1.0909	1.0098	9414	8824	8304	7840	7421	7038	6687	6362	6059	52
53	1.8320	1.5032	1.3183	1.1889	1.0894	1.0085	9404	8814	8296	7832	7414	7032	6681	6357	6055	53
54	1.8239	1.4994	1.3158	1.1871	1.0880	1.0073	9393	8805	8288	7825	7407	7026	6676	6351	6050	54
55	1.8159	1.4956	1.3133	1.1852	1.0865	1.0061	9383	8796	8279	7818	7401	7020	6670	6346	6045	55
56	1.8081	1.4918	1.3108	1.1834	1.0850	1.0049	9372	8787	8271	7811	7394	7014	6664	6341	6040	56
57	1.8004	1.4881	1.3083	1.1816	1.0835	1.0036	9362	8778	8263	7803	7387	7008	6659	6330	6035	57
58	1.7929	1.4844	1.3059	1.1797	1.0821	1.0024	9351	8769	8255	7796	7381	7002	6653	6331	6030	58
59	1.7855	1.4808	1.3034	1.1779	1.0806	1.0012	9341	8760	8247	7789	7374	6996	6648	6325	6025	59
60	1.7782	1.4771	1.3010	1.1761	1.0792	1.0000	9331	8751	8239	7782	7368	6990	6642	6320	6021	60
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	

LOGISTICAL LOGARITHMS.

° ′	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	° ′
′ ″	900	960	1020	1080	1140	1200	1260	1320	1380	1440	1500	1560	1620	1680	1740	′ ″
0	6021	5740	5477	5229	4994	4771	4559	4357	4164	3979	3802	3632	3468	3310	3158	0
1	6016	5736	5473	5225	4990	4768	4556	4354	4161	3976	3799	3629	3465	3307	3155	1
2	6011	5731	5469	5221	4986	4764	4552	4351	4158	3973	3796	3626	3463	3305	3153	2
3	6006	5727	5464	5217	4983	4760	4549	4347	4155	3970	3793	3623	3460	3302	3150	3
4	6001	5722	5460	5213	4979	4757	4546	4344	4152	3967	3791	3621	3457	3300	3148	4
5	5997	5718	5456	5209	4975	4753	4542	4341	4149	3964	3788	3618	3454	3297	3145	5
6	5992	5713	5452	5205	4971	4750	4539	4338	4145	3961	3785	3615	3452	3294	3143	6
7	5987	5709	5447	5201	4967	4746	4535	4334	4142	3958	3782	3612	3449	3292	3140	7
8	5982	5704	5443	5197	4964	4742	4532	4331	4139	3955	3779	3610	3446	3289	3138	8
9	5977	5700	5439	5193	4960	4739	4528	4328	4136	3952	3776	3607	3444	3287	3135	9
10	5973	5695	5435	5189	4956	4735	4525	4325	4133	3949	3773	3604	3441	3284	3133	10
11	5968	5691	5430	5185	4952	4732	4522	4321	4130	3946	3770	3601	3438	3282	3130	11
12	5963	5686	5426	5181	4949	4728	4518	4318	4127	3943	3768	3598	3436	3279	3128	12
13	5958	5682	5422	5177	4945	4724	4515	4315	4124	3940	3765	3596	3433	3276	3125	13
14	5954	5677	5418	5173	4941	4721	4511	4311	4120	3937	3762	3593	3431	3274	3123	14
15	5949	5673	5414	5169	4937	4717	4508	4308	4117	3934	3759	3590	3428	3271	3120	15
16	5944	5669	5409	5165	4933	4714	4505	4305	4114	3931	3756	3587	3425	3269	3118	16
17	5939	5664	5405	5161	4930	4710	4501	4302	4111	3928	3753	3585	3423	3266	3115	17
18	5935	5660	5401	5157	4926	4707	4498	4298	4108	3925	3750	3582	3420	3264	3113	18
19	5930	5655	5397	5153	4922	4703	4494	4295	4105	3922	3747	3579	3417	3261	3110	19
20	5925	5651	5393	5149	4918	4699	4491	4292	4102	3919	3745	3576	3415	3259	3108	20
21	5920	5646	5389	5145	4915	4696	4488	4289	4099	3917	3742	3574	3412	3256	3105	21
22	5916	5642	5384	5141	4911	4692	4484	4285	4096	3914	3739	3571	3409	3253	3103	22
23	5911	5637	5380	5137	4907	4689	4481	4282	4092	3911	3736	3568	3407	3251	3101	23
24	5906	5633	5376	5133	4903	4685	4477	4279	4089	3908	3733	3565	3404	3248	3098	24
25	5902	5629	5372	5129	4900	4682	4474	4276	4086	3905	3730	3563	3401	3246	3096	25
26	5897	5624	5368	5125	4896	4678	4471	4273	4083	3902	3727	3560	3399	3243	3093	26
27	5892	5620	5364	5122	4892	4675	4467	4269	4080	3899	3725	3557	3396	3241	3091	27
28	5888	5615	5359	5118	4889	4671	4464	4266	4077	3896	3722	3555	3393	3238	3088	28
29	5883	5611	5355	5114	4885	4668	4460	4263	4074	3893	3719	3552	3391	3236	3086	29
30	5878	5607	5351	5110	4881	4664	4457	4260	4071	3890	3716	3549	3388	3233	3083	30
31	5874	5602	5347	5106	4877	4660	4454	4256	4068	3887	3713	3546	3386	3231	3081	31
32	5869	5598	5343	5102	4874	4657	4450	4253	4065	3884	3710	3544	3383	3228	3078	32
33	5864	5594	5339	5098	4870	4653	4447	4250	4062	3881	3708	3541	3380	3225	3076	33
34	5860	5589	5335	5094	4866	4650	4444	4247	4059	3878	3705	3538	3378	3223	3073	34
35	5855	5585	5331	5090	4863	4646	4440	4244	4055	3875	3702	3535	3375	3220	3071	35
36	5850	5580	5326	5086	4859	4643	4437	4240	4052	3872	3699	3533	3372	3218	3069	36
37	5846	5576	5322	5082	4855	4639	4434	4237	4049	3869	3696	3530	3370	3215	3066	37
38	5841	5572	5318	5079	4852	4636	4430	4234	4046	3866	3693	3527	3367	3213	3064	38
39	5836	5567	5314	5075	4848	4632	4427	4231	4043	3863	3691	3525	3365	3210	3061	39
40	5832	5563	5310	5071	4844	4629	4424	4228	4040	3860	3688	3522	3362	3208	3059	40
41	5827	5559	5306	5067	4841	4625	4420	4224	4037	3857	3685	3519	3359	3205	3056	41
42	5823	5554	5302	5063	4837	4622	4417	4221	4034	3855	3682	3516	3357	3203	3054	42
43	5818	5550	5298	5059	4833	4618	4414	4218	4031	3852	3679	3514	3354	3200	3052	43
44	5813	5546	5294	5055	4830	4615	4410	4215	4028	3849	3677	3511	3351	3198	3049	44
45	5809	5541	5290	5051	4826	4611	4407	4212	4025	3846	3674	3508	3349	3195	3047	45
46	5804	5537	5285	5048	4822	4608	4404	4209	4022	3843	3671	3506	3346	3193	3044	46
47	5800	5533	5281	5044	4819	4604	4400	4205	4019	3840	3668	3503	3344	3190	3042	47
48	5795	5528	5277	5040	4815	4601	4397	4202	4016	3837	3665	3500	3341	3188	3039	48
49	5790	5524	5273	5036	4811	4597	4394	4199	4013	3834	3663	3497	3338	3185	3037	49
50	5786	5520	5269	5032	4808	4594	4390	4196	4010	3831	3660	3495	3336	3183	3034	50
51	5781	5516	5265	5028	4804	4590	4387	4193	4007	3828	3657	3492	3333	3180	3032	51
52	5777	5511	5261	5025	4800	4587	4384	4189	4004	3825	3654	3489	3331	3178	3030	52
53	5772	5507	5257	5021	4797	4584	4380	4186	4001	3822	3651	3487	3328	3175	3027	53
54	5768	5503	5253	5017	4793	4580	4377	4183	3998	3820	3649	3484	3325	3173	3025	54
55	5763	5498	5249	5013	4789	4577	4374	4180	3995	3817	3646	3481	3323	3170	3022	55
56	5758	5494	5245	5009	4786	4573	4370	4177	3991	3814	3643	3479	3320	3168	3020	56
57	5754	5490	5241	5005	4782	4570	4367	4174	3988	3811	3640	3476	3318	3165	3018	57
58	5749	5486	5237	5002	4778	4566	4364	4171	3985	3808	3637	3473	3315	3163	3015	58
59	5745	5481	5233	4998	4775	4563	4361	4167	3982	3805	3635	3471	3313	3160	3013	59
60	5740	5477	5229	4994	4771	4559	4357	4164	3979	3802	3632	3468	3310	3158	3010	60
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	

LOGISTICAL LOGARITHMS.

° ′	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	° ′
′ ″	1800	1860	1920	1980	2040	2100	2160	2220	2280	2340	2400	2460	2520	2580	2640	′ ″
0	3010	2868	2730	2596	2467	2341	2218	2099	1984	1871	1761	1654	1549	1447	1347	0
1	3008	2866	2728	2594	2465	2339	2216	2098	1982	1869	1759	1652	1547	1445	1345	1
2	3005	2863	2725	2592	2462	2337	2214	2096	1980	1867	1757	1650	1546	1443	1344	2
3	3003	2861	2723	2590	2460	2335	2212	2094	1978	1865	1755	1648	1544	1442	1342	3
4	3001	2859	2721	2588	2458	2333	2210	2092	1976	1863	1754	1647	1542	1440	1340	4
5	2998	2856	2719	2585	2456	2331	2208	2090	1974	1862	1752	1645	1540	1438	1339	5
6	2996	2854	2716	2583	2454	2328	2206	2088	1972	1860	1750	1643	1539	1437	1337	6
7	2993	2852	2714	2581	2452	2326	2204	2086	1970	1858	1748	1641	1537	1435	1335	7
8	2991	2849	2712	2579	2450	2324	2202	2084	1968	1856	1746	1640	1535	1433	1334	8
9	2989	2847	2710	2577	2448	2322	2200	2082	1967	1854	1745	1638	1534	1432	1332	9
10	2986	2845	2707	2574	2445	2320	2198	2080	1965	1852	1743	1636	1532	1430	1331	10
11	2984	2842	2705	2572	2443	2318	2196	2078	1963	1850	1741	1634	1530	1428	1329	11
12	2981	2840	2703	2570	2441	2316	2194	2076	1961	1849	1739	1633	1528	1427	1327	12
13	2979	2838	2701	2568	2439	2314	2192	2074	1959	1847	1737	1631	1527	1425	1326	13
14	2977	2835	2698	2566	2437	2312	2190	2072	1957	1845	1736	1629	1525	1423	1324	14
15	2974	2833	2696	2564	2435	2310	2188	2070	1955	1843	1734	1627	1523	1422	1322	15
16	2972	2831	2694	2561	2433	2308	2186	2068	1953	1841	1732	1626	1522	1420	1321	16
17	2969	2828	2692	2559	2431	2306	2184	2066	1951	1839	1730	1624	1520	1418	1319	17
18	2967	2826	2689	2557	2429	2304	2182	2064	1950	1838	1728	1622	1518	1417	1317	18
19	2965	2824	2687	2555	2426	2302	2180	2062	1948	1836	1727	1620	1516	1415	1316	19
20	2962	2821	2685	2553	2424	2300	2178	2061	1946	1834	1725	1619	1515	1413	1314	20
21	2960	2819	2683	2551	2422	2298	2176	2059	1944	1832	1723	1617	1513	1412	1313	21
22	2958	2817	2681	2548	2420	2296	2174	2057	1942	1830	1721	1615	1511	1410	1311	22
23	2955	2815	2678	2546	2418	2294	2172	2055	1940	1828	1719	1613	1510	1408	1309	23
24	2953	2812	2676	2544	2416	2291	2170	2053	1938	1827	1718	1612	1508	1407	1308	24
25	2950	2810	2674	2542	2414	2289	2169	2051	1936	1825	1716	1610	1506	1405	1306	25
26	2948	2808	2672	2540	2412	2287	2167	2049	1934	1823	1714	1608	1504	1403	1304	26
27	2946	2805	2669	2538	2410	2285	2165	2047	1933	1821	1712	1606	1503	1402	1303	27
28	2943	2803	2667	2535	2408	2283	2163	2045	1931	1819	1711	1605	1501	1400	1301	28
29	2941	2801	2665	2533	2405	2281	2161	2043	1929	1817	1709	1603	1499	1398	1300	29
30	2939	2798	2663	2531	2403	2279	2159	2041	1927	1816	1707	1601	1498	1397	1298	30
31	2936	2796	2660	2529	2401	2277	2157	2039	1925	1814	1705	1599	1496	1395	1296	31
32	2934	2794	2658	2527	2399	2275	2155	2037	1923	1812	1703	1598	1494	1393	1295	32
33	2931	2792	2656	2525	2397	2273	2153	2035	1921	1810	1702	1596	1493	1392	1293	33
34	2929	2789	2654	3522	2395	2271	2151	2033	1919	1808	1700	1594	1491	1390	1291	34
35	2927	2787	2652	2520	2393	2269	2149	2032	1918	1806	1698	1592	1489	1388	1290	35
36	2924	2785	2649	2518	2391	2267	2147	2030	1916	1805	1696	1591	1487	1387	1288	36
37	2922	2782	2647	2516	2389	2265	2145	2028	1914	1803	1694	1589	1486	1385	1287	37
38	2920	2780	2645	2514	2387	2263	2143	2026	1912	1801	1693	1587	1484	1383	1285	38
39	2917	2778	2643	2512	2384	2261	2141	2024	1910	1799	1690	1585	1482	1382	1283	39
40	2915	2775	e640	2510	2382	2259	2139	2022	1908	1797	1689	1584	1481	1380	1282	40
41	2912	2773	2638	2507	2380	2257	2137	2020	1906	1795	1687	1582	1479	1378	1280	41
42	2910	2771	2636	2505	2378	2255	2135	2018	1904	1794	1686	1580	1477	1377	1278	42
43	2908	2769	2634	2503	2376	2253	2133	2016	1903	1792	1684	1578	1476	1375	1277	43
44	2905	2766	2632	2501	2374	2251	2131	2014	1901	1790	1682	1577	1474	1373	1275	44
45	2903	2764	2629	2499	2372	2249	2129	2012	1899	1788	1680	1575	1472	1372	1274	45
46	2901	2762	2627	2497	2370	2247	2127	2010	1897	1786	1678	1573	1470	1370	1272	46
47	2898	2760	2625	2494	2368	2245	2125	2009	1895	1785	1677	1571	1469	1368	1270	47
48	2896	2757	2623	2492	2366	2243	2123	2007	1893	1783	1675	1570	1467	1367	1269	48
49	2894	2755	2621	2490	2364	2241	2121	2005	1891	1781	1673	1568	1465	1365	1267	49
50	2891	2753	2618	2488	2362	2239	2119	2003	1889	1779	1671	1566	1464	1363	1266	50
51	2889	2750	2616	2486	2359	2237	2117	2001	1888	1777	1670	1565	1462	1362	1264	51
52	2887	2748	2614	2484	2357	2235	2115	1999	1886	1775	1668	1563	1460	1360	1262	52
53	2884	2746	2612	2482	2355	2233	2113	1997	1884	1774	1666	1561	1459	1359	1261	53
54	2882	2744	2610	2480	2353	2231	2111	1995	1882	1772	1664	1559	1457	1357	1259	54
55	2880	2741	2607	2477	2351	2229	2109	1993	1880	1770	1663	1558	1455	1355	1257	55
56	2877	2739	2605	2475	2349	2227	2107	1991	1878	1768	1661	1556	1454	1354	1256	56
57	2875	2737	2603	2473	2347	2225	2105	1989	1876	1766	1659	1554	1452	1352	1254	57
58	2873	2735	2601	2471	2345	2223	2103	1987	1875	1765	1657	1552	1450	1350	1253	58
59	2870	2732	2599	2469	2343	2220	2101	1986	1873	1763	1655	1551	1449	1349	1251	59
60	2868	2730	2596	2467	2341	2218	2099	1984	1871	1761	1654	1549	1447	1347	1249	60
	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	

LOGISTICAL LOGARITHMS.

° ′	45′	46	47	48	49	50	51	52	53	54	55	56	57	58	59	° ′
′ ″	2700	2760	2820	2880	2940	3000	3060	3120	3180	3240	3300	3360	3420	3480	3540	′ ″
0	1249	1154	1061	0969	0880	0792	0706	0621	0539	0458	0378	0300	0223	0147	0073	0
1	1248	1152	1059	0968	0878	0790	0704	0620	0537	0456	0377	0298	0221	0146	0072	1
2	1246	1151	1057	0966	0877	0789	0703	0619	0536	0455	0375	0297	0220	0145	0071	2
3	1245	1149	1056	0965	0875	0787	0702	0617	0535	0454	0374	0296	0219	0143	0069	3
4	1243	1148	1054	0963	0874	0786	0700	0616	0533	0452	0373	0294	0218	0142	0068	4
5	1241	1146	1053	0962	0872	0785	0699	0615	0532	0451	0371	0293	0216	0141	0067	5
6	1240	1145	1051	0960	0871	0783	0697	0613	0531	0450	0370	0292	0215	0140	0066	6
7	1238	1143	1050	0959	0869	0782	0696	0612	0529	0448	0369	0291	0214	0139	0064	7
8	1237	1141	1048	0957	0868	0780	0694	0610	0528	0447	0367	0289	0213	0137	0063	8
9	1235	1140	1047	0956	0866	0779	0693	0609	0526	0446	0366	0288	0211	0136	0062	9
10	1233	1138	1045	0954	0865	0777	0692	0608	0525	0444	0365	0287	0210	0135	0061	10
11	1232	1137	1044	0953	0863	0776	0690	0606	0524	0443	0363	0285	0209	0134	0060	11
12	1230	1135	1042	0951	0862	0774	0689	0605	0522	0442	0362	0284	0208	0132	0058	12
13	1229	1134	1041	0950	0860	0773	0687	0603	0521	0440	0361	0283	0206	0131	0057	13
14	1227	1132	1039	0948	0859	0772	0686	0602	0520	0439	0359	0282	0205	0130	0056	14
15	1225	1130	1037	0947	0857	0770	0685	0601	0518	0438	0358	0280	0204	0129	0055	15
16	1224	1129	1036	0945	0856	0769	0683	0599	0517	0436	0357	0279	0202	0127	0053	16
17	1222	1127	1034	0944	0855	0767	0682	0598	0516	0435	0356	0278	0201	0126	0052	17
18	1221	1126	1033	0942	0853	0766	0680	0596	0514	0434	0354	0276	0200	0125	0051	18
19	1219	1124	1031	0941	0852	0764	0679	0595	0513	0432	0353	0275	0199	0124	0050	19
20	1217	1123	1030	0939	0850	0763	0678	0594	0512	0431	0352	0274	0197	0122	0049	20
21	1216	1121	1028	0938	0849	0762	0676	0592	0510	0430	0350	0273	0196	0121	0047	21
22	1214	1119	1027	0936	0847	0760	0675	0591	0509	0428	0349	0271	0195	0120	0046	22
23	1213	1118	1025	0935	0846	0759	0673	0590	0507	0427	0348	0270	0194	0119	0045	23
24	1211	1116	1024	0933	0844	0757	0672	0588	0506	0426	0346	0269	0192	0117	0044	24
25	1209	1115	1022	0932	0843	0756	0670	0587	0505	0424	0345	0267	0191	0116	0042	25
26	1208	1113	1021	0930	0841	0754	0669	0585	0503	0423	0344	0266	0190	0115	0041	26
27	1206	1112	1019	0929	0840	0753	0668	0584	0502	0422	0342	0265	0189	0114	0040	27
28	1205	1110	1018	0927	0838	0751	0666	0583	0501	0420	0341	0264	0187	0112	0039	28
29	1203	1109	1016	0926	0837	0750	0665	0581	0499	0419	0340	0262	0186	0111	0038	29
30	1201	1107	1015	0924	0835	0749	0663	0580	0498	0418	0339	0261	0185	0110	0036	30
31	1200	1105	1013	0923	0834	0747	0662	0579	0497	0416	0337	0260	0184	0109	0035	31
32	1198	1104	1012	0921	0833	0746	0661	0577	0495	0415	0336	0258	0182	0107	0034	32
33	1197	1102	1010	0920	0831	0744	0659	0576	0494	0414	0335	0257	0181	0106	0033	33
34	1195	1101	1008	0918	0830	0743	0658	0574	0493	0412	0333	0256	0180	0105	0031	34
35	1193	1099	1007	0917	0828	0741	0656	0573	0491	0411	0332	0255	0179	0104	0030	35
36	1192	1098	1005	0915	0827	0740	0655	0572	0490	0410	0331	0253	0177	0103	0029	36
37	1190	1096	1004	0914	0825	0739	0654	0570	0489	0408	0329	0252	0176	0101	0028	37
38	1189	1095	1002	0912	0824	0737	0652	0569	0487	0407	0328	0251	0175	0100	0027	38
39	1187	1093	1001	0911	0822	0736	0651	0568	0486	0406	0327	0250	0174	0099	0025	39
40	1186	1091	0999	0909	0821	0734	0649	0566	0484	0404	0326	0248	0172	0098	0024	40
41	1184	1090	0998	0908	0819	0733	0648	0565	0483	0403	0324	0247	0171	0096	0023	41
42	1182	1088	0996	0906	0818	0731	0647	0563	0482	0402	0323	0246	0170	0095	0022	42
43	1181	1087	0995	0905	0816	0730	0645	0562	0480	0400	0322	0244	0169	0094	0021	43
44	1179	1085	0993	0903	0815	0729	0644	0561	0479	0399	0320	0243	0167	0093	0019	44
45	1178	1084	0992	0902	0814	0727	0642	0559	0478	0398	0319	0242	0166	0091	0018	45
46	1176	1082	0990	0900	0812	0726	0641	0558	0476	0396	0318	0241	0165	0090	0017	46
47	1174	1081	0989	0899	0811	0724	0640	0557	0475	0395	0316	0239	0163	0089	0016	47
48	1173	1079	0987	0897	0809	0723	0638	0555	0474	0394	0315	0238	0162	0088	0015	48
49	1171	1078	0986	0896	0808	0721	0637	0554	0472	0392	0314	0237	0161	0087	0013	49
50	1170	1076	0984	0894	0806	0720	0635	0552	0471	0391	0313	0235	0160	0085	0012	50
51	1168	1074	0983	0893	0805	0719	0634	0551	0470	0390	0311	0234	0158	0084	0011	51
52	1167	1073	0981	0891	0803	0717	0633	0550	0468	0388	0310	0233	0157	0083	0010	52
53	1165	1071	0980	0890	0802	0716	0631	0548	0467	0387	0309	0232	0156	0082	0008	53
54	1163	1070	0978	0888	0801	0714	0630	0547	0466	0386	0307	0230	0155	0080	0007	54
55	1162	1068	0977	0887	0799	0713	0628	0546	0464	0384	0306	0229	0153	0079	0006	55
56	1160	1067	0975	0885	0798	0711	0627	0544	0463	0383	0305	0228	0152	0078	0005	56
57	1159	1065	0974	0884	0796	0710	0626	0543	0462	0382	0304	0227	0151	0077	0004	57
58	1157	1064	0972	0883	0795	0709	0624	0541	0460	0381	0302	0225	0150	0075	0002	58
59	1156	1062	0971	0881	0793	0707	0623	0540	0459	0379	0301	0224	0148	0074	0001	59
60	1154	1061	0969	0880	0792	0706	0621	0539	0458	0378	0300	0223	0147	0073	0000	60
	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	

LOGISTICAL LOGARITHMS.

° '	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	° '
' ''	3600	3660	3720	3780	3840	3900	3960	4020	4080	4140	4200	4260	4320	4380	4440	' ''
0	0000	9928	9858	9788	9720	9652	9586	9521	9456	9393	9331	9269	9208	9148	9089	0
1	9999	9927	9856	9787	9719	9651	9585	9520	9455	9392	9329	9268	9207	9147	9088	1
2	9998	9926	9855	9786	9717	9650	9584	9519	9454	9391	9328	9267	9206	9146	9087	2
3	9996	9925	9854	9785	9716	9649	9583	9518	9453	9390	9327	9266	9205	9145	9086	3
4	9995	9923	9853	9784	9715	9648	9582	9516	9452	9389	9326	9265	9204	9144	9085	4
5	9994	9922	9852	9782	9714	9647	9581	9515	9451	9388	9325	9264	9203	9143	9084	5
6	9993	9921	9851	9781	9713	9646	9579	9514	9450	9387	9324	9263	9202	9142	9083	6
7	9992	9920	9849	9780	9712	9645	9578	9513	9449	9386	9323	9262	9201	9141	9082	7
8	9990	9919	9848	9779	9711	9643	9577	9512	9448	9385	9322	9261	9200	9140	9081	8
9	9989	9918	9847	9778	9710	9642	9576	9511	9447	9384	9321	9260	9199	9139	9080	9
10	9988	9916	9846	9777	9708	9641	9575	9510	9446	9383	9320	9259	9198	9138	9079	10
11	9987	9915	9845	9775	9707	9640	9574	9509	9445	9381	9319	9258	9197	9137	9078	11
12	9986	9914	9844	9774	9706	9639	9573	9508	9444	9380	9318	9257	9196	9136	9077	12
13	9984	9913	9842	9773	9705	9638	9572	9507	9443	9379	9317	9256	9195	9135	9076	13
14	9983	9912	9841	9772	9704	9637	9571	9506	9442	9378	9316	9255	9194	9134	9077	14
15	9982	9910	9840	9771	9703	9636	9570	9505	9440	9377	9315	9254	9193	9133	9075	15
16	9981	9909	9839	9770	9702	9635	9569	9504	9439	9376	9314	9253	9192	9132	9074	16
17	9980	9908	9838	9769	9701	9633	9567	9502	9438	9375	9313	9252	9191	9131	9073	17
18	9978	9907	9837	9767	9699	9632	9566	9501	9437	9374	9312	9251	9190	9130	9072	18
19	9977	9906	9835	9766	9698	9631	9565	9500	9436	9373	9311	9250	9189	9129	9071	19
20	9976	9905	9834	9765	9697	9630	9564	9499	9435	9372	9310	9249	9188	9128	9070	20
21	9975	9903	9833	9764	9696	9629	9563	9498	9434	9371	9309	9248	9187	9128	9069	21
22	9974	9902	9832	9763	9695	9628	9562	9497	9433	9370	9308	9247	9186	9127	9068	22
23	9972	9901	9831	9762	9694	9627	9561	9496	9432	9369	9307	9246	9185	9126	9067	23
24	9971	9900	9830	9761	9693	9626	9560	9495	9431	9368	9306	9245	9184	9125	9066	24
25	9970	9899	9829	9759	9692	9625	9559	9494	9430	9367	9305	9244	9183	9124	9065	25
26	9969	9897	9827	9758	9690	9624	9558	9493	9429	9366	9304	9243	9182	9123	9064	26
27	9968	9896	9826	9757	9689	9622	9557	9492	9428	9365	9303	9241	9181	9122	9063	27
28	9966	9895	9825	9756	9688	9621	9555	9491	9427	9364	9302	9240	9180	9121	9062	28
29	9965	9894	9824	9755	9687	9620	9554	9490	9426	9363	9301	9239	9179	9120	9061	29
30	9964	9893	9823	9754	9686	9619	9553	9488	9425	9362	9300	9238	9178	9119	9060	30
31	9963	9892	9822	9753	9685	9618	9552	9487	9424	9361	9299	9237	9177	9118	9059	31
32	9962	9890	9820	9751	9684	9617	9551	9486	9422	9360	9298	9236	9176	9117	9058	32
33	9960	9889	9819	9750	9683	9616	9550	9485	9421	9359	9297	9235	9175	9116	9057	33
34	9959	9888	9818	9749	9681	9615	9549	9484	9420	9358	9296	9234	9174	9115	9056	34
35	9958	9887	9817	9748	9680	9614	9548	9483	9419	9356	9294	9233	9173	9114	9055	35
36	9957	9886	9816	9747	9679	9612	9547	9482	9418	9355	9293	9232	9172	9113	9054	36
37	9956	9885	9815	9746	9678	9611	9546	9481	9417	9354	9292	9231	9171	9112	9053	37
38	9954	9883	9813	9745	9677	9610	9545	9480	9416	9353	9291	9230	9170	9111	9052	38
39	9953	9882	9812	9744	9676	9609	9544	9479	9415	9352	9290	9229	9169	9110	9051	39
40	9952	9881	9811	9742	9675	9608	9542	9478	9414	9351	9289	9228	9168	9109	9050	40
41	9951	9880	9810	9741	9674	9607	9541	9477	9413	9350	9288	9227	9167	9108	9049	41
42	9950	9879	9809	9740	9672	9606	9540	9476	9412	9349	9287	9226	9166	9107	9048	42
43	9948	9877	9808	9739	9671	9605	9539	9475	9411	9348	9286	9225	9165	9106	9047	43
44	9947	9876	9807	9738	9670	9604	9538	9473	9410	9347	9285	9224	9164	9105	9046	44
45	9946	9875	9805	9737	9669	9603	9537	9472	9409	9346	9284	9223	9163	9104	9045	45
46	9945	9874	9804	9736	9668	9601	9536	9471	9408	9345	9283	9222	9162	9103	9044	46
47	9944	9873	9803	9734	9667	9600	9535	9470	9407	9344	9282	9221	9161	9102	9043	47
48	9942	9872	9802	9733	9666	9599	9534	9469	9406	9343	9281	9220	9160	9101	9042	48
49	9941	9870	9801	9732	9665	9598	9533	9468	9405	9342	9280	9219	9159	9100	9042	49
50	9940	9869	9800	9731	9664	9597	9532	9467	9404	9341	9279	9218	9158	9099	9041	50
51	9939	9868	9798	9730	9662	9596	9530	9466	9402	9340	9278	9217	9157	9098	9040	51
52	9938	9867	9797	9729	9661	9595	9529	9465	9401	9339	9277	9216	9156	9097	9039	52
53	9937	9866	9796	9728	9660	9594	9528	9464	9400	9338	9276	9215	9155	9096	9038	53
54	9935	9865	9795	9727	9659	9593	9527	9463	9399	9337	9275	9214	9154	9095	9037	54
55	9934	9863	9794	9725	9658	9592	9526	9462	9398	9336	9274	9213	9153	9094	9036	55
56	9933	9862	9793	9724	9657	9590	9525	9461	9397	9335	9273	9212	9152	9093	9035	56
57	9932	9861	9792	9723	9656	9589	9524	9460	9396	9334	9272	9211	9151	9092	9034	57
58	9931	9860	9790	9722	9655	9588	9523	9459	9395	9333	9271	9210	9150	9091	9033	58
59	9929	9859	9789	9721	9653	9587	9522	9457	9394	9332	9270	9209	9149	9090	9032	59
60	9928	9858	9788	9720	9652	9586	9521	9456	9393	9331	9269	9208	9148	9089	9031	60
	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	

LOGISTICAL LOGARITHMS.

° ′	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	° ′
′ ″	4500	4560	4620	4680	4740	4800	4860	4920	4980	5040	5100	5160	5220	5280	5340	′ ″
0	9031	8973	8917	8861	8805	8751	8697	8644	8591	8539	8488	8437	8387	8337	8288	0
1	9030	8972	8916	8860	8804	8750	8696	8643	8590	8538	8487	8436	8386	8336	8287	1
2	9029	8971	8915	8859	8803	8749	8695	8642	8589	8537	8486	8435	8385	8335	8286	2
3	9028	8971	8914	8858	8802	8748	8694	8641	8589	8537	8485	8434	8384	8335	8286	3
4	9027	8970	8913	8857	8802	8747	8693	8640	8588	8536	8484	8433	8383	8334	8285	4
5	9026	8969	8912	8856	8801	8746	8692	8639	8587	8535	8484	8433	8383	8333	8284	5
6	9025	8968	8911	8855	8800	8745	8692	8638	8586	8534	8483	8432	8382	8332	8283	6
7	9024	8967	8910	8854	8799	8745	8691	8638	8585	8533	8482	8431	8381	8331	8282	7
8	9023	8966	8909	8853	8798	8744	8690	8637	8584	8532	8481	8430	380	8330	8281	8
9	9022	8965	8908	8852	8797	8743	8689	8636	8583	8531	8480	8429	8379	8330	8281	9
10	9021	8964	8907	8851	8796	8742	8688	8635	8582	8530	8479	8428	8379	8329	8280	10
11	9020	8963	8906	8850	8795	8741	8687	8634	8582	8530	8478	8428	8378	8328	8279	11
12	9019	8962	8905	8849	8794	8740	8686	8633	8581	8529	8477	8427	8377	8327	8278	12
13	9018	8961	8904	8849	8793	8739	8685	8632	8580	8528	8477	8426	8376	8326	8278	13
14	9017	8960	8903	8848	8792	8738	8684	8631	8579	8527	8476	8425	8375	8325	8277	14
15	9016	8959	8903	8847	8792	8737	8684	8631	8578	8526	8475	8424	8374	8325	8276	15
16	9015	8958	8902	8846	8791	8736	8683	8630	8577	8525	8474	8423	8373	8324	8275	16
17	9015	8957	8901	8845	8790	8736	8682	8629	8576	8524	8473	8423	8373	8323	8274	17
18	9014	8956	8900	8844	8789	8735	8681	8628	8575	8524	8472	8422	8372	8322	8273	18
19	9013	8955	8899	8843	8788	8734	8680	8627	8575	8523	8472	8421	8371	8322	8273	19
20	9012	8954	8898	8842	8787	8733	8679	8626	8574	8522	8471	8420	8370	8321	8272	20
21	9011	8953	8897	8841	8786	8732	8678	8625	8573	8521	8470	8419	8369	8320	8271	21
22	9010	8952	8896	8840	8785	8731	8677	8624	8572	8520	8469	8418	8368	8319	8270	22
23	9009	8952	8895	8839	8784	8730	8677	8624	8571	8519	8468	8418	8368	8318	8269	23
24	9008	8951	8894	8838	8783	8729	8676	8623	8570	8518	8467	8417	8367	8317	8268	24
25	9007	8950	8893	8837	8782	8728	8675	8622	8569	8518	8467	8416	8366	8317	8268	25
26	9006	8949	8892	8837	8781	8727	8674	8621	8568	8517	8466	8415	8365	8316	8267	26
27	9005	8948	8891	8836	8781	8727	8673	8620	8568	8516	8465	8414	8364	8315	8266	27
28	9004	8947	8890	8835	8780	8726	8672	8619	8567	8515	8464	8413	8363	8314	8265	28
29	9003	8946	8889	8834	8779	8725	8671	8618	8566	8514	8463	8413	8363	8313	8265	29
30	9002	8945	8888	8833	8778	8724	8670	8617	8565	8513	8462	8412	8362	8312	8264	30
31	9001	8944	8888	8832	8777	8723	8669	8617	8564	8513	8461	8411	8361	8312	8263	31
32	9000	8943	8887	8831	8776	8722	8668	8616	8563	8512	8460	8410	8360	8311	8262	32
33	8999	8942	8886	8830	8775	8721	8668	8615	8562	8511	8460	8409	8359	8310	8261	33
34	8998	8941	8885	8829	8774	8720	8667	8614	8561	8510	8459	8408	8358	8309	8260	34
35	8997	8940	8884	8828	8773	8719	8666	8613	8561	8509	8458	8408	8358	8308	8260	35
36	8996	8939	8883	8827	8772	8718	8665	8612	8560	8508	8457	8407	8357	8307	8259	36
37	8995	8938	8882	8826	8771	8718	8664	8611	8559	8507	8456	8406	8356	8307	8258	37
38	8994	8937	8881	8825	8771	8717	8663	8610	8558	8506	8455	8405	8355	8306	8257	38
39	8993	8936	8880	8825	8770	8716	8662	8610	8557	8506	8455	8404	8354	8305	8257	39
40	8992	8935	8879	8824	8769	8715	8661	8609	8556	8505	8454	8403	8353	8304	8256	40
41	8992	8935	8878	8823	8768	8714	8661	8608	8556	8504	8453	8403	8353	8304	8255	41
42	8991	8934	8877	8822	8767	8713	8660	8607	8555	8503	8452	8402	8352	8303	8254	42
43	8990	8933	8876	8821	8766	8712	8659	8606	8554	8502	8451	8401	8351	8302	8253	43
44	8989	8932	8875	8820	8765	8711	8658	8605	8553	8501	8450	8400	8350	8301	8252	44
45	8988	8931	8875	8819	8764	8710	8657	8604	8552	8501	8450	8399	8350	8300	8252	45
46	8987	8930	8874	8818	8763	8709	8656	8603	8551	8500	8449	8398	8349	8299	8251	46
47	8986	8929	8873	8817	8762	8709	8655	8603	8550	8499	8448	8398	8348	8299	8250	47
48	8985	8928	8872	8816	8761	8708	8654	8602	8549	8498	8447	8397	8347	8298	8249	48
49	8984	8927	8871	8815	8761	8707	8654	8601	8549	8497	8446	8396	8346	8297	8248	49
50	8983	8926	8870	8814	8760	8706	8653	8600	8548	8496	8445	8395	8345	8296	8247	50
51	8982	8925	8869	8813	8759	8705	8652	8599	8547	8495	8445	8394	8345	8295	8247	51
52	8981	8924	8868	8813	8758	8704	8651	8598	8546	8494	8444	8393	8344	8294	8246	52
53	8980	8923	8867	8812	8757	8703	8650	8597	8545	8494	8443	8392	8343	8294	8245	53
54	8979	8922	8866	8811	8756	8702	8649	8596	8544	8493	8442	8392	8342	8293	8244	54
55	8978	8921	8865	8810	8755	8702	8648	8596	8543	8492	8441	8391	8341	8292	8244	55
56	8977	8920	8864	8809	8754	8701	8647	8595	8542	8491	8440	8390	8340	8291	8243	56
57	8976	8919	8863	8808	8753	8700	8646	8594	8542	8490	8440	8389	8340	8291	8242	57
58	8975	8918	8862	8807	8752	8699	8645	8593	8541	8489	8439	8388	8339	8290	8241	58
59	8974	8918	8861	8806	8752	8698	8645	8592	8540	8489	8438	8388	8338	8289	8240	59
60	8973	8917	8861	8805	8751	8697	8644	8591	8539	8488	8437	8387	8337	8288	8239	60
	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	

HERE

HERE FOLLOWS THE Seaman's Ready Computer:

BEING AN

IMPROVEMENT in *Tabular* NAVIGATION.

Whereby *any Perſon* underſtanding *Addition*, is qualified to keep a SHIP's Reckoning at SEA; in *Latitude*, *Departure*, and LONGITUDE:

As by which *eaſy* TABLE, the *Ship's Place*, at any Time, may be ſpeedily taken out, (like the SUN's mean *Place* from *Aſtronomical Tables:)*

And all *practical Queſtions* in NAVIGATION and *Plane* TRIGONOMETRY are readily anſwered, without Logarithm-*Sines*, *Tangents*, or other *artificial* Numbers:

Of which ſee Examples further on.

By this ſufficiently *near Method* of *travelling at Sea*, aſſiſted by *Helps* contained in this Work, for determining the *Longitudes* from *Greenwich*, *Spheroidical* Navigation is exploded, as uſeleſs.

FOR, as Mr. EMERSON judiciouſly obſerves, at P. vi. *Preface* to his NAVIGATION, (containing the exact *Rules* and their *Demonſtrations* on the Principles of *ſpherical* Navigation) to which Our NAVIGATION is *ſupplemental*. " *It would be an idle Refinement to deduce a Table of* meridional *Parts from the* Spheroid. *That it would require all the Parallel* " *of Latitude and Arches of the Meridian to be altered accordingly; creating an endleſs Deal of Trouble for* no real *Advan-* " *tage. That, if we conſider that no Ship can ſteer true to a* Degree, *or hardly to a* Quarter Point *of the Compaſs, nor* " *can meaſure her Diſtance ſailed by the* Log, *to any ſuch Degree of* Exactneſs, *but that there will always be a conſiderable* " *Variation from the* preciſe *Truth, in Regard to the Ship's* Place, *for which Reaſon ſhe is obliged, as often as poſſible, to* " *correct her Latitude and Longitude by Obſervation. Therefore (he concludes) it would be quite* trifling *to deſcend to ſuch* " minute *Differences as can have no ſenſible Effect in* Practice. *That, ſince ſuch is the Difference betwixt* ſpherical *and* " ſpheroidical *Navigation, if we muſt needs* wander *from the Truth, we had better do it in a plain and eaſy Way than in a* " *rigid and difficult one.*"

Mr. EMERSON then proceeds to lay down *his Rules* of ſpherical Navigation (agreeing with *ours*) as ſhort and plain as poſſible; " *Diſincumbering the Seaman of every Thing long and tedious, and giving him as much Satisfaction as he* " *will ever find, or can wiſh for.*"

To which may be added. That every Perſon's Experience (having travelled by Sea) will inform him of the Truth of the foregoing Aſſertions. And a Perſon we know is perfectly convinced thereof, in three Voyages he made to the *Weſt Indies*, and one to *Greenland*. That the *Errors* by *Lee Way*, and miſtaken Courſe, and Diſtance run by the Log, from their various Cauſes (of *Wind, Sails ſet, high Seas, Currents, &c.)* are with *Doubt* and *Difficulty* corrected. But a *ſpheroidical Navigator*, having never been a Voyage, if he goes one to keep a Ship's Reckoning, will find himſelf involved in greater Errors than thoſe he pretends to correct; ſince there is always much more Difference in Mens Judgments about ſettling the *Lee-Way*, *Currents*, *Courſe*, and *Diſtance*, than there is betwixt *ſpherical* and *ſpheroidical* Navigation.

OUR *ſhort and eaſy Method of computing a Ship's Way through the Ocean*, is an Improvement from a Table we have lately ſeen at the End of *Sherwin's Mathematical Tables*, reviſed by *Gardiner*; but did not ſee till we contrived our *own Table*, Computer No. I. *for that Purpoſe* (conſtructed from natural Sines) in a more general Way, as follows. *Computers* No. I. II. are quite a NEW INVENTION.

The SEAMAN's READY COMPUTER. N°. I.

∠ Course		Base.	Perp.	Base.	Perp.	Base.	Perp.	Base.	Perp.	Base.	Perp.	Base.	Perp.	Base.	Perp.	Base.	Perp.	Base.	Perp.	∠ Course	
		DISTANCE sailed, or HYPOTHENUSE as below.																			
		10000		20000		30000		40000		50000		60000		70000		80000		90000			
Pts.	D.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D.	Pts.
	1	09998	00175	19997	00349	29995	00524	39994	00698	49992	00873	59991	01047	69989	01222	79988	01396	89986	01571	89	
	2	09994	00349	19988	00698	29982	01047	39976	01396	49970	01745	59963	02094	69957	02443	79951	02792	89945	03141	88	
0¼	...	09988	00491	19976	00981	29964	01472	39952	01963	49940	02453	59928	02944	69916	03435	79904	03925	89892	04410	...	7¾
	3	09986	00523	19973	01047	29959	01570	39945	02093	49931	02617	59918	03140	69904	03664	79890	04187	89877	04710	87	
	4	09976	00698	19951	01395	29927	02093	39903	02790	49878	03488	59854	04185	69829	04883	79805	05580	89781	06278	86	
	5	09962	00872	19924	01743	29886	02615	39848	03486	49810	04358	59772	05229	69734	06101	79696	06972	89658	07844	85	
0½	...	09952	00980	19904	01960	29856	02940	39807	03921	49759	04901	59711	05881	69663	06861	79615	07841	89567	08822	...	7½
	6	09945	01045	19890	02091	29836	03136	39781	04181	49726	05226	59671	06272	69617	07317	79562	08362	89507	09408	84	
	7	09925	01219	19851	02437	29776	03656	39702	04875	49627	06093	59553	07312	69478	08531	79404	09750	89329	10968	83	
	8	09903	01392	19805	02783	29708	04175	39611	05567	49513	06959	59416	08350	69319	09742	79221	11134	89124	12526	82	
0¾	...	09892	01467	19784	02935	29675	04402	39567	05869	49459	07337	59351	08804	69242	10271	79134	11738	89026	13206	...	7¼
	9	09877	01564	19754	03129	29631	04693	39508	06257	49384	07822	59261	09386	69138	10950	79015	12515	88892	14079	81	
	10	09848	01736	19696	03473	29544	05209	39392	06946	49240	08682	59088	10419	68937	12155	78785	13892	88633	15628	80	
	11	09816	01908	19633	03816	29449	05724	39265	07632	49081	09540	58898	11449	68714	13357	78530	15265	88346	17173	79	
1	...	09808	01951	19616	03902	29424	05853	39231	07804	49039	09754	58847	11705	68655	13656	78463	15607	88271	17558	...	7
	12	09781	02079	19563	04158	29344	06237	39126	08316	48907	10396	58689	12475	68470	14554	78252	16633	88033	18712	78	
	13	09744	02250	19487	04499	29231	06749	38975	08998	48718	11248	58462	13497	68206	15746	77950	17996	87693	20246	77	
	14	09703	02419	19406	04838	29108	07258	38812	09677	48515	12096	58218	14515	67921	16935	77624	19354	87327	21773	76	
1¼	...	09700	02430	19401	04860	29101	07289	38801	09719	48502	12149	58202	14579	67902	17009	77602	19438	87303	21868	...	6¾
	15	09659	02588	19319	05176	28978	07765	38637	10353	48296	12941	57956	15529	67615	18117	77274	20706	86933	23294	75	
	16	09613	02756	1922[illegible]	05513	28838	08269	38450	11025	48063	13782	57676	16538	67288	19295	76901	22051	86513	24807	74	
1½	..	09569	02903	19139	05806	28708	08709	38278	11611	47847	14514	57416	17417	66986	20320	76555	23223	86125	26126	...	6½
	17	09563	02924	19126	05847	28689	08771	38252	11695	47815	14619	57378	17542	66941	20466	76504	23390	86067	26313	73	
	18	09511	03090	19021	06180	28532	09271	38042	12361	47553	15451	57063	18541	66574	21631	76084	24721	85595	27812	72	
	19	09455	03256	18910	06511	28366	09767	37821	13023	47276	16278	56731	19534	66186	22790	75642	26045	85097	29301	71	
1¾	...	09415	03369	18831	06738	28246	10107	37662	13476	47077	16844	56493	20213	65908	23582	75324	26951	84739	30320	...	6¼
	20	09397	03420	18794	06840	28191	10261	37588	13681	46985	17101	56382	20521	65779	23941	75175	27362	84572	30782	70	
	21	09336	03584	18672	07167	2800[illegible]	10751	37343	14335	46679	17918	56015	21502	65351	25086	74686	28669	84022	32253	69	
	22	09272	03746	18544	07492	27816	11238	37087	14984	46359	18730	55631	22476	64903	26222	74175	29969	83447	33715	68	
2	...	09239	03827	18478	07654	27716	11480	36955	15307	46194	19134	55433	22961	64672	26788	73910	30615	83149	34441	...	6
	23	09205	03907	18410	07815	27615	11722	36820	15629	46025	19537	55230	23444	64435	27351	73640	31258	82845	35166	67	
	24	09135	04067	18270	08135	27406	12202	36542	16269	45677	20337	54813	24404	63948	28472	73084	32539	82219	36606	66	
	25	09063	04226	18126	08452	27189	12679	36252	16905	45315	21131	54378	25357	63442	29583	72505	33809	81568	38036	65	
2¼	...	09040	04276	18080	08551	27120	12827	36160	17102	45199	21378	54239	25653	63279	29929	72319	34204	81359	38480	...	5¾
	26	08988	04384	17976	08767	26964	13151	35952	17535	44940	21919	53928	26302	62916	30686	71904	35070	80891	39453	64	
	27	08910	04540	17820	09080	26730	13620	35640	18160	44550	22699	53460	27239	62370	31779	71280	36319	80191	40859	63	
	28	08829	04695	17659	09389	26488	14084	35318	18779	44147	23474	52977	28168	61806	32863	70630	37558	79465	42252	62	
2½	...	08819	04714	17638	09428	26458	14142	35277	18856	44096	23570	52915	28284	61734	32998	70554	37712	79373	42426	...	5½
	29	08746	04848	17492	09696	26239	14544	34985	19392	43731	24240	52477	29089	61223	33937	69970	38785	78716	43633	61	
	30	08660	05000	17320	10000	25981	15000	34641	20000	43301	25000	51961	30000	60622	35000	69282	40000	77942	45000	60	
2¾	...	08577	05141	17155	10282	25732	15423	34309	20564	42886	25705	51464	30846	60041	35987	68618	41128	77196	46269	...	5¼
	31	08572	05150	17143	10301	25715	15451	34287	20602	42858	25752	51430	30902	60002	36052	68573	41203	77145	46353	59	
	32	08480	05299	16961	10598	25441	15896	33922	21197	42402	26496	50883	31795	59363	57094	67843	42394	76324	47693	58	
	33	08387	05446	16773	10893	25160	16339	33547	21786	41934	27232	50320	32678	58707	38125	67094	43571	75480	4901[illegible]	57	
3	...	08315	05556	16629	11111	24944	16667	33259	22223	41573	27778	49888	33334	58203	38890	66518	44446	74832	50001	...	5
	34	08290	05592	16581	11184	24871	16776	33162	22368	41452	27960	49742	33552	58033	39144	66323	44735	74613	50327	56	
	35	08192	05736	16383	11472	24575	17207	32766	22943	40958	28679	49149	34415	57341	40150	65532	45886	73724	51622	55	
	36	08090	05878	16180	11756	24271	17634	32361	23511	40451	29389	48541	35267	56631	41145	64721	47023	72812	52901	54	
3¼	...	08032	05957	16064	11914	24096	17871	32128	23828	40160	29785	48192	35742	56224	41699	64257	47656	72289	53613	...	4¾
	37	07986	06018	15973	12036	23959	18054	31945	24073	39932	30091	47918	36109	55904	42127	63891	48145	71877	54163	53	
	38	07880	06157	15760	12313	23640	18470	31520	24626	39401	30783	47281	36940	55161	43096	63041	49253	70921	55409	52	
	39	07771	06293	15543	12586	23314	18880	31086	25173	38857	31466	46629	37759	54400	44052	62172	50346	69943	56639	51	
3½	...	07730	06344	15460	12688	23190	19032	30920	25376	38650	31720	46381	38064	54111	44408	61841	50751	69571	57095	...	4½
	40	07660	06428	15321	12856	22981	19284	30642	25712	38302	32139	45963	38567	53623	44995	61284	51423	68944	57851	50	
	41	07547	06561	15094	13121	22641	19682	30188	36242	37736	32803	45283	39363	52830	45924	60377	52485	67924	59045	49	
	42	07431	06691	14863	13383	22294	20074	29726	26765	37157	33457	44589	40148	52020	46839	59452	53530	66883	60222	48	
3¾	...	07410	06716	14819	13431	22229	20147	29638	26862	37048	33578	44457	40294	51867	47009	59270	53725	66680	60440	...	4¼
	43	07314	06820	14628	13640	21941	20460	29254	27280	36568	34100	43881	40920	51195	47740	58508	54560	65822	61380	47	
	44	07193	06947	14387	13894	21580	20840	28774	27786	35967	34733	43160	41670	50354	48626	57547	55573	64741	62519	46	
4	45	07071	07071	14142	14142	21213	21213	28284	28284	35355	35355	42426	42426	49497	49497	56569	56569	63640	63640	45	4
Pts.	D.	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	Dep.	D. Lat	D.	Pts.
Course		10000		20000		30000		40000		50000		60000		70000		80000		90000		Course	

Construction, 1, 2, 3, 4, 5, 6, 7, 8, 9 Times the natural Cosines and Sines to Radius 10000.

USE

USE of the SEAMAN's READY COMPUTER.

The Distances sailed, or Hypothenuses, at the Top and Bottom of the Table, may signify any of the Numbers below.

10000	20000	30000	40000	50000	60000	70000	80000	90000
1000	2000	3000	4000	5000	6000	7000	8000	9000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9

Under or above which stand the correspondent Dif. of Lat. and Departure, or Base and Perpend. against the Course or ∠, on one Side of the Table, to be taken in equal whole Numbers. Those to the Right of these being Decimals.

THEREFORE, the Difference of *Latitude* and *Departure*, (or Base and Perpendicular) answerable to the given Distance sailed (or Hypothenuse of a right angled Triangle) on a given Course, or Angle, must be taken out by Parts, and *added together*; taking out first for the highest Number of *Tens*, then for next Tens less, and so down to *Units*; according to the Numbers of Figures in the *Distance sailed*, (or Hypothenuse of a Triangle) to be taken out for.

PROPOSITION I. *To find the Difference of Latitude and Departure from the Course and Distance given? Or to find the Base and Perpendicular from an acute Angle and the Hypothenuse of a Triangle being given?*

EXAMPLE I. *Required the Difference of Latitude and Departure, when a Ship has sailed* 85 *Miles, on a* S. W. *and by* S. *Course* ½ *Point Westerly; being* 3½ *Points to the Westward?*

	Dist.	Dif. Lat. S.	Depart. W.
Against 3½ Points under	80	61.841	50.751
	5	3.868	3.172
Miles	85	65.709	53.923 Answer.

But two Decimals to the Right of any whole Number will be sufficient in taking out; except where Accuracy is required, in Trigonometry.

EXAMPLE II. *A Ship having sailed* 116 *Miles, on a Course of* 41 *Degrees from the North, easterly, required her Difference of Latitude and Departure?*

	Dist.	Dif. Lat. N.	Dep. E.
Against 41° under	100	75.47	65.61
	10	7.54	6.56
	6	4.53	3.94
Miles	116	87.54	76.11

Answer.

EXAMPLE III. *Required the Base and Perpendicular of a right angled Triangle, having an acute Angle equal to* 23°, *and its Hypothenuse equal to* 1543?

	Hypoth.	Base.	Perp.
Against 23° under	1000	920,5	390.70
	500	460,25	195.37
	40	36,820	15.629
	3	2,761	1.172
Answer	1543	1420,332	602.871

EXAMPLE IV. *Required the Base and Perpendicular of a right angled plain Triangle, having an acute Angle equal to* 66°, *and its Hypothenuse equal to* 77?

	Dist.	Base.	Perp.
Against 66° under	70	63.948	28.472
	7	6.395	2.847
Answer	77	70.343	31.319

A TABLE shewing the *Angles* that every *Point of the Compass* makes with the *Meridian*: For turning *Rhumbs*, or the Course, steered by the Ship, into Degrees, and the *contrary*.

North		*Points.*	*D. M. S.*	*South*	
		0¼	2 48 45		
		0½	5 37 30		
		0¾	8 26 15		
N. by E.	*N. by W.*	1	11 15 0	*S. by E.*	*S. by W.*
		1¼	14 3 45		
		1½	16 52 30		
		1¾	19 41 15		
N. N. E.	*N. N. W.*	2	22 30 0	*S. S. E.*	*S. S. W.*
		2¼	25 18 45		
		2½	28 7 30		
		2¾	30 56 15		
N.E. by N.	*N.W. by N*	3	33 45 0	*S. E. by S.*	*S. W. by S.*
		3¼	36 33 45		
		3½	39 22 30		
		3¾	42 11 15		
Nor. East	*Nor. West*	4	45 0 0	*Sou. East*	*Sou. West*
		4¼	47 48 45		
		4½	50 37 30		
		4¾	53 26 15		
N.E. by E.	*N.W. by W.*	5	56 15 0	*S. E. by E.*	*S.W. by W.*
		5¼	59 3 45		
		5½	61 52 30		
		5¾	64 41 15		
E. N. E.	*W. N. W.*	6	67 30 0	*E. S. E.*	*W. S. W.*
		6¼	70 18 45		
		6½	73 7 30		
		6¾	75 56 15		
E. by N.	*W. by N.*	7	78 45 0	*E. by S.*	*W. by S.*
		7¼	81 33 45		
		7½	84 22 30		
		7¾	87 11 15		
East	*West*	8	90 0 0	*East*	*West*

USE of the SEAMAN's READY COMPUTER.

PROPOSITION II. *To find the Difference of Latitude and Departure from* several *Courses and Distances sailed; or to work a Ship's Traverse; to find the Miles in a* Degree *of Latitude, or take a* Map *of an Estate, or County?*

MAKE a *Traverse-Table*, as on the right Hand, and place therein each Course and Distance. Then find the Difference of Latitude and Departure to each Course, by the foregoing *Proposition*, placing them in their proper Columns.

NOW, the Difference of the *Sums* of the *Northing* and *Southing*, will be the whole Difference of Latitude; and the Difference of the *Sums* of *Easting* and *Westing*, will be the whole Departure.

EXAMPLE. *The Difference of Latitude and Departure of a Ship sailing several Courses and Distances, will be found as in the adjoining Table, by the former Proposition.*

Courses.	Dist. Miles.	Diff. Latitude. North.	Diff. Latitude. South.	Departure. East.	Departure. West.
N. 85° W.	70	06.101	....	....	69.734
S. S. W. ¾ W.	37	....	31.736	....	19.022
S. 40° W.	84	....	64.348	....	53.994
S. S. E. ½ E.	79	....	69.671	37.241	....
S. 49° E.	148	....	97.096	111.697	....
N. E. ½ E.	86	54.557	....	66.479	....
		60.658	262.851 60.658	215.417 142.750	142.750
		Dif. Lat.	202.193 Miles.	72.667 Miles.	Depart.

The above PROPOSITION finds the Miles in a Degree of Latitude, and is extensively useful in surveying *Estates*, *Counties*, or large *Tracts* of Land. Mr. *Norwood*, in the Year 1635, made Use of it in determining the Difference of Latitude (according to the Method in the foregoing Traverse-Table) between the Parallels of *London* and *York* of given Latitudes, by cœlestial Observation; and so determines, *very near* the Truth, the Miles in a Degree of Latitude. *(See his Seaman's Practice, since reprinted for* W. Mount *and* T. Page, *on* Tower-Hill.) For, he measuring the several Distances between all the Turnings of the Road, from *London* to *York*, as the Road led him, at the same Time he observed the several Bearings betwixt those Turnings, by his *Circumferentor*, he then determined, by Trigonometry, the several *Differences* of Latitude and Departure*; *(which is done at Sight by our Easy Computer)* and thence he determined the Distance, or Miles, Difference of Latitude, between the Parallels of *London* and *York*, and also Distance of those Meridians. And consequently the Miles in a Degree of Latitude, by Proportion of the Miles in the Degrees, Difference of Latitude, by Observation. If which *Bearings* and *Distances* were again taken and measured, more correctly, *according to the last improved Methods of Surveying*, there is no Doubt, but that the *Distance* between the Parallels of *London* and *York* (on so large an Arc of the Meridian) might be determined with as much *Accuracy*, as that *Distance* (measured by the *French*) was determined between the two Parallels near the *Polar Circle*.

In surveying Counties (or even Estates) by the Bearings and Distances of their Circuits, the Use of the *Needle* (not always keeping Parallel with itself) is not to be trusted to; but the several Bearings and Distances must be taken and measured by the *correcter Methods* known. And, in *plotting* the Survey of a County, by *Circuit Station Lines*, (though consisting of never so many) they may be reduced to a *small Number*, for the first *Plan* or Closing. And the like Method should be pursued in plotting the intermediate Circuit Stations betwixt each two plotted Stations in the first Plan, and so on; whereby every Circuit Station will be more correctly placed than by any other Method; and the *resulting Out line* or *Plan*, will be as near the Truth as possible.

At every Bearing taken, each Distance between the several Circuit-Stations, may be measured in *Chains*, of 100 Feet, or by any other Measure, *(to be inserted in a Station or Traverse-Table, as above)* correspondent to which, the several Differences of *Latitude* and *Departure*, or Northings and Southings, and Eastings and Westings, will be found in the same Measure, taken out of the *ready Computer*, for plotting each Station, and the whole Tract of Land.

* REMARK. *The Meridional Distance, and Departure* (of Easting and Westing) *are manifestly different. In sailing towards the* Pole, *the Departure is the greater, because of the nearer and nearer Approach of the Meridians cross'd over by the same Course, for one Time. But in sailing towards the* Equator *the Departure is less than the* meridional Distance; because the Meridians cross'd over by the same Course, for one Time, grow wider, or recede more and more from one another: *The Departure being of a* middle Quantity *(especially on one Course) between the Meridional Distances of two Places, for the Parallel departed from and for that arrived in. The Longitude is invariable, between any two Places, or Parallels, and different from the Meridional Distance and Departure. The Meridional Distance is different in different Parallels; and the Departure is only the same, for a* single Course, *between two Parallels; because many different Courses* (in long Runs) *will have many manifest Differences in the Meridional Distance, on which the* Sum *of the several Departures depend. This makes* no Error *between short Parallels of Latitude,* (from Day to Day's Reckoning) *on the* plain Chart.

USE of the SEAMAN's COMPUTER.

PROPOSITION III. *To find the Course and Distance, from the Difference of Latitude and Departure given?*

RULE I. Find the given *Difference* of Latitude and Departure together, in some of the *Columns* of the *Seaman's* READY COMPUTER Number I, or find the *nearest Numbers* to them, and even therewith, on the Side of the Page, is found the *Course*; and the *Distance* is found at the Top or Bottom of the Page, in the *Column* of given *Latitude and Departure.*

EXAMPLE. *To find the Course and Distance answering to 700 Miles Difference of Latitude Southerly, and 388 Miles Departure Westerly?*

In the Column 80000 you will find 699.70 Miles Difference of Latitude, and 387.85 Miles Departure, the nearest Numbers to those given, even with which *tabular* Numbers you find the *Course* S. 29° *westerly*; and, at the Top of the Column of the given Latitude and Departure, you find 800 (taking an equal Number of Figures) the *Distance* correspondent, *required.*

RULE II. If the given Difference of *Latitude* and *Departure* cannot be found together or in near Numbers, you must divide the *less* by the *greater* Number (Difference of Latitude by Departure, or Departure by Difference of Latitude, according as which happens to be the greater) and ascertaining a *few Figures* in the Quotient, find the *nearest Number* answering thereto, in the Column under 10000, of COMPUTER Number II. *following*, (which, in all Cases, you will readily find, without Stop, or Difficulty, by casting the Eye along the Column) and even with the said *Quotient*-Figures stands the *Course*, on the Side; and the Distance is found by taking it out of the said *Ready Computer* Number II. answerable to the given Difference of Latitude.

EXAMPLE. In the former *Instance*, 700)388(,554 which *Quote* is immediately found against 29°, the Course South-westerly, as before. And against which Course, under 700, Difference of Latitude, *(in the Column 70000)* will be found 800,45 or 800 Miles for the *Distance*, required.

But, UNIVERSALLY. *Required the Course and Distance answerable to 971 Miles, Difference of Latitude, South; and 1117 Miles Departure, easterly?*

1117)971,000(,869 which *Quote* is immediately found against 49°, Column 10000, in the *Seaman's Computer*, Number II. following; which is the required *Course*, South-easterly.

```
1117)971,000(,869
     8936
     ----
      7740
      6702
      ----
      10380
      10053
      -----
        327
```

☞ WHEN (of the Difference of Latitude and Departure) *the Departure is the* greater, *the Course is above* 45°; *but when the Difference of Latitude is the* greater, *the Course is less than* 45°.

NOW, by the Seaman's *Ready Computer*, Number II. following, always take out for the greater,

Course S.	Depart. E.	Distance.
Against 49°	Under 1000	1325,0
or 41	100	132,50
	10	13,250
	7	9,275
	Miles 1117	1480,025
		Answer.

Hence, also the two Legs of a plane right-angled Triangle being given, the acute Angles and Hypothenuse may be found in the same Manner.

N. B. *When the greater Side* (either Latitude or Departure) *and an Angle is given* (or the Course) *the less Side* (Departure or Latitude) *and also the Hypothenuse* (or Distance run) *may be found by* Computer, Number II. *But the* less Side *and an Angle being given, the* REST *cannot be found but by* Computer, Number III. following.

PROPOSITION IV. *Having the* greater *of either Difference of Latitude or Departure, and also the* Course *given, to find the* less *of either, of Difference of Latitude or Departure, and also Distance sailed.*

This *Proposition* is universally answered as in the foregoing *Example*, by the *Seaman's Computer*, Number II.

EXAMPLE II. *Course under* 45° (viz. N. 36° westerly) *and Difference of Latitude* 349 *Miles, to find the Departure and Distance sailed?*

Course.	Dif. Lat. N.	Depart. W.	Distance.
Against 36°	Under 300	217.96	370.82
	40	29.062	49.443
	9	6.539	11.125
	Miles 349	253.561	431.388
		Answer.	

Hence, the *less* Side and Hypothenuse, of any right-angled plane Triangle, are found in the same Manner, from having an acute Angle, and a greater Side, or Leg given.

PROPOSITION V. *Having the less of either the Difference of Latitude or Departure, and also the Course given to find the greater of either the Difference of Latitude or Departure, and also the Distance sailed?*

This *Proposition* is solved in all Respects exactly like the former, but by a different Computer, Number III. following, by taking out the greater LEG and Distance to the less LEG and the given Course, instead of less LEG and Distance to the greater LEG, and given Course, by *Computer*, Number II.

The *Seaman*'s Ready COMPUTER. N°. II. A New Improvement.

∠		Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	Perp.	Hyp.	∠	
		Given *Difference* of LATITUDE. Course under 45°.—Or greater LEG given, next the given ∠, under 45°.																			
Course		10000		20000		30000		40000		50000		60000		70000		80000		90000		Course	
Pts	D.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	D.	Pts.
	1	00175	10002	00349	20003	00524	30005	00698	40006	00873	50008	01047	60009	01222	70011	01396	80012	01571	90014	89	
	2	00349	10006	00698	20012	01048	30018	01397	40024	01746	50030	02095	60037	02444	70043	02794	80049	03143	90055	88	
¼	...	00491	10012	00983	20024	01474	30036	01965	40048	02456	50060	02947	60072	03439	70084	03940	80096	04421	90108	...	7¾
	3	00524	10014	01048	20027	01572	30041	02096	40055	02620	50069	03144	60102	03668	70096	04192	80110	04717	90123	87	
	4	00699	10024	01399	20059	02098	30073	02797	40097	03496	50122	04196	60146	04895	70171	05594	80195	06293	90220	86	
	5	00875	10038	01750	20076	02625	30114	03500	40153	04374	50191	05249	60229	06124	70267	06999	80306	07874	90344	85	
½	...	00985	10048	01970	20097	02955	30145	03940	40193	04925	50242	05909	60290	06894	70339	07879	80387	08864	90436	...	7½
	6	01051	10055	02102	20110	03153	30165	04204	40220	05255	50275	06306	60330	07357	70386	08408	80441	09459	90496	84	
	7	01228	10075	02456	20150	03684	30225	04911	40300	06139	50375	07367	60450	08595	70525	09823	80600	11051	90675	83	
	8	01405	10098	02811	20197	04216	30295	05622	40393	07027	50491	08732	60589	09838	70688	11243	80786	12649	90884	82	
¾	...	01483	10109	02967	20219	04450	30328	05933	40438	07417	50547	08900	60657	10384	70766	11867	80875	13350	90985	...	7¼
	9	01584	10125	03168	20249	04752	30374	06335	40499	07919	50623	09503	60748	11087	70873	12671	80997	14255	91122	81	
	10	01763	10154	03527	20308	05290	30463	07053	40617	08816	50771	10580	60926	12343	71089	14106	81234	15869	91388	80	
	11	01944	10187	03888	20374	05831	30561	07775	40749	09719	50936	11663	61123	13607	71310	15550	81497	17494	91684	79	
1	...	01989	10196	03978	20392	05967	30588	07956	40784	09946	50980	11935	61175	13924	71371	15913	81567	17902	91763	...	7
	12	02126	10223	04251	20447	06377	30670	08502	40894	10628	51117	12753	61340	14879	71564	17004	81787	19130	92011	78	
	13	02309	10263	04617	20526	06926	30789	09235	41052	11543	51315	13852	61578	16161	71841	18469	82104	20778	92367	77	
	14	02493	10306	04986	20612	07480	30918	09973	41224	12466	51531	14960	61837	17453	72143	19946	82449	22440	92755	76	
1¼	...	02505	10309	05010	20618	07515	30927	10019	41236	12524	51545	15029	61854	17534	72163	20039	82472	22544	92780	...	6¾
	15	02679	10353	05359	20706	08038	31058	10718	41411	13397	51764	16077	62117	18756	72469	21436	82822	24115	93175	75	
	16	02867	10403	05735	20806	08602	31209	11470	41612	14337	52015	17205	62418	20072	72821	22940	83224	25807	93627	74	
1½	...	03033	10450	06067	20900	09100	31350	12334	41800	15167	52250	18201	62700	21234	73150	24265	83600	27301	94050	...	6½
	17	03057	10457	06115	20914	09172	31271	12229	41828	15286	52285	18344	62741	21401	73198	24458	83655	27516	94112	73	
	18	03249	10515	06298	21029	09748	31544	12997	42058	16246	52573	19495	63088	22744	73602	25994	84117	29243	94631	72	
	19	03443	10576	06887	21152	10330	31729	13773	42305	17216	52881	20660	63457	24103	74033	27546	84610	30989	95186	71	
1¾	...	03578	10621	07156	20242	10734	31863	14312	42483	17890	33104	21468	63725	25046	74346	28624	84967	32202	95588	...	6¼
	20	03640	10642	07279	21284	10919	31925	14539	42567	18198	53209	21838	63851	25478	74492	29118	85134	33757	95776	70	
	21	03839	10711	07677	21423	11516	32134	15355	42846	19193	53557	23032	64269	26870	74980	30709	85692	34548	96403	69	
	22	04040	10785	08081	21572	12121	32356	16161	43141	20201	53927	24242	64712	28281	74497	32322	86283	36362	97068	68	
2	...	04142	10824	08284	21648	12426	32472	16569	43296	20911	54120	24853	64944	28995	75767	33137	86591	37279	97415	...	6
	23	04245	10864	08489	21727	12734	32591	16979	43454	21224	54318	25468	65182	29713	76045	33957	86909	38203	97772	67	
	24	04452	10946	08905	21893	13357	32839	17809	43785	22261	54732	26714	65678	31166	76625	35618	87571	40071	98517	66	
	25	04663	11034	09326	22068	13989	33101	18652	44135	23315	55169	27978	66203	32641	77236	37304	88270	41967	99304	65	
2¼	...	04730	11062	09459	22124	14189	33186	18919	44248	23648	55310	28378	66372	33108	77434	37837	88496	42567	99558	...	5¾
	26	04877	11126	09755	22252	14632	33378	19509	44504	24387	55630	29254	66756	34121	77882	39019	89008	43856	10.0134	64	
	27	05095	11223	10190	22447	15286	33670	20381	44893	25476	56116	30572	67340	35667	78563	40762	89786	45927	10.1009	63	
	28	05317	11326	10634	22651	15951	33977	21268	45303	26585	56628	31902	67954	37219	79280	42536	90606	47853	10.1931	62	
2½	...	05345	11339	10690	22678	16035	34017	21380	45356	26726	56694	32071	68033	37416	79372	42761	90711	48106	10.2050	...	5½
	29	05543	11433	11080	22867	16629	34301	22172	45734	27715	57168	33258	68601	38801	80045	44344	91468	49887	10 2902	61	
	30	05773	11547	11547	23094	17320	34641	23094	46188	28867	57735	34641	69282	40414	80829	46188	92376	51961	10.3923	60	
2¾	...	05994	11659	11988	23317	17981	34976	23975	46635	29969	58293	35962	69952	41956	81613	47950	93270	53944	10.4928	...	5¼
	31	06009	11666	12017	23333	18026	34999	24034	46665	30043	58332	36052	69998	42060	81664	48069	93331	54077	10.4997	59	
	32	06249	11792	12497	23584	18746	35375	24995	47167	31243	58959	37492	70751	43743	82542	49990	94334	56238	10.6126	58	
	33	06494	11924	12988	23847	19482	35771	25976	47695	32470	59618	38964	71542	45458	83465	51952	95389	58446	10.7313	57	
3	...	06682	12027	13364	24054	20045	36081	26727	48108	33409	60134	40091	72161	46772	84188	53454	96215	60136	10.8242	...	5
	34	06745	12062	13490	24124	20235	36186	26980	48248	33725	60311	40470	72373	47215	84435	53960	96497	60705	10.8560	56	
	35	07002	12208	14004	24415	21006	36623	28008	48831	35010	61039	42012	73246	49014	85454	56016	97262	63018	10.9870	55	
	36	07265	12361	14531	24721	21796	37082	29062	49443	36327	61803	43593	74164	50858	86525	58123	98885	65389	11.1246	54	
3¼	...	07416	12450	14833	24900	22250	37350	29666	49800	37083	62250	44499	74700	51916	87150	59332	99600	66749	11.2050	...	4¾
	37	07536	12521	15071	25043	22607	37564	30142	50085	37678	62607	45213	75128	52749	87649	60284	10.0171	67820	11.2692	53	
	38	07813	12690	15626	25380	23439	38071	31251	50761	39064	63451	46877	76141	54690	88831	62503	10.1521	70306	11.4212	52	
	39	08098	12868	16196	25735	24294	38603	32391	51470	40489	64328	48587	77206	56685	90073	64783	10.2941	72881	11.5808	51	
3½	...	08207	12936	16414	25872	24620	38809	32827	51746	41034	64681	49241	77619	57447	90555	65654	10.3491	73861	11.6428	...	4½
	40	08391	13054	16782	26008	25173	39162	33564	52216	41955	65270	50346	78024	58737	91378	67128	10.4432	75519	11.7486	50	
	41	08693	13250	17386	26500	26079	39750	34771	53000	43464	66250	52157	79500	60850	92750	69543	10.6000	78236	11.9250	49	
	42	09004	13456	18008	26913	27012	40369	36016	53825	45020	67282	54024	80738	63028	94194	72032	10.7651	81036	12.1107	48	
3¾	...	09063	13496	18127	26992	27190	40488	36254	53985	45317	67481	54381	80977	63444	94473	72508	10.7969	81571	12.1465	...	4¼
	43	09325	13673	18650	27347	27975	41020	37301	54693	46626	98366	55951	82040	65276	95713	74601	10.9386	83926	12.3055	47	
	44	09657	13902	19314	27803	28971	41705	38628	55607	48285	69508	57942	83410	67599	97311	77256	11.1211	86913	12.5115	46	
4	45	10000	14142	20000	28284	30000	42426	40000	56569	50000	70711	60000	84853	70000	98995	80000	11.3137	90000	12.7279	45	4
Pts.	D.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D. Lat	Dist.	D.	Pts.
Course		10000		20000		30000		40000		50000		60000		70000		80000		90000		Course	
		Given DEPARTURE. Course above 45°. — Or greater LEG given, opposite to the given ∠, above 45°.																			

CONSTRUCTION. 1, 2, 3, 4, 5, 6, 7, 8, 9 Times the natural *Tangents* and *Secants* to Radius 10000.

Th:

The *Seaman*'s Ready COMPUTER. N°. III. A New Improvement.

∠		Base.	Hyp.	Base.	Hyp.	Base.	Hyp.	Base.	Hyp.	Base.	Hyp.	Base.	Hyp.	∠	
		Given DEPARTURE. Course under 45°.—Or Less LEG, opposite an ∠ given, under 45°.													
Course		10000		20000		30000		40000		50000		60000		Course	
Pts.	D	D. Lat.	Dist.	D. Lat.	Dist.	D. Lat.	Dist.	D. Lat.	Dist.	D. Lat.	Dist.	D. Lat.	Dist.	D.	Pts.
	1	57.2900	57.2987	114.5799	114.5974	171.8699	171.8961	229.1598	229.1948	286.4498	286.4934	343.7398	343.7921	89	
	2	28.6363	28.6537	57.2725	57.3074	85.9088	85.9611	114.5450	114.6148	143.1813	143.2685	171.8175	171.9222	88	
¼	...	20.3556	20.3802	40.7112	40.7603	61.0668	61.1404	81.4224	81.5206	101.7780	101.9007	122.1336	122.2809	...	7¾
	3	19.0811	19.1073	38.1623	38.2146	57.2434	57.3220	76.3245	76.4293	95.4057	95.5366	114.4868	114.6439	87	
	4	14.3007	14.3356	28.6013	28.6712	42.9020	43.0068	57.2027	57.3423	71.5033	71.6779	85.8040	86.0135	86	
	5	11.4300	11.4737	22.8601	22.9474	34.2902	34.4211	45.7202	45.8948	57.1502	57.3686	68.5803	68.8423	85	
½	...	10.1532	10.2024	20.3064	20.4048	30.4596	30.6073	40.6128	40.8097	50.7660	51.0121	60.9192	61.2145	...	7½
	6	95144	95668	19.0287	19.1335	28.5431	28.7003	38.0575	38.2671	47.5718	47.8338	57.0862	57.4006	84	
	7	81443	82055	16.2887	16.4110	24.4330	24.6165	32.5774	32.8220	40.7217	40.2775	48.8661	49.2330	83	
	8	71154	71853	14.2307	14.3706	21.3461	21.5559	28.4615	28.7412	35.5768	35.9265	42.6922	43.1118	82	
¾	...	67415	68152	13.4829	13.6305	20.2244	20.4457	26.9658	27.2609	33.7073	34.0761	40.4487	40.8914	...	7¼
	9	63138	63925	12.6275	12.7849	18.9413	19.1774	25.2550	25.5698	31.5688	31.9622	37.8825	38.3547	81	
	10	56713	57588	11.3426	11.5175	17.0138	17.2763	22.6851	23.0351	28.3564	28.7939	34.0277	34.5526	80	
	11	51446	52408	10.2891	10.4817	15.4337	15.7225	20.5782	20.9634	25.7228	26.2042	30.8673	31.4451	79	
1	...	50273	51258	10.0547	10.2517	15.0820	15.3775	20.1094	20.5033	25.1367	25.6292	30.1640	30.7550	...	7
	12	47046	48097	94093	96195	14.1139	14.4292	18.8185	19.2389	23.5232	24.0486	28.2278	28.8584	78	
	13	43315	44454	86630	88908	12.9944	13.3362	17.3259	17.7816	21.6574	22.2271	25.9889	26.6725	77	
	14	40108	41336	80215	82671	12.0323	12.4007	16.0431	16.5343	20.0539	20.6678	24.0647	24.8014	76	
1¼	...	39922	41156	79844	82311	11.9767	12.3467	15.9689	16.4623	19.9611	20.5778	23.9533	24.6934	...	6¾
	15	37321	38637	74641	77274	11.1962	11.5911	14.9280	15.4548	18.6603	19.3185	22.392	23.1822	75	
	16	34874	36280	69748	72559	10.4622	10.8839	13.9496	14.5118	17.4371	18.1398	20.9245	21.7677	74	
1½	...	32966	34449	65931	68898	98897	10.3347	13.1862	13.7796	16.4828	17.2245	19.7794	20.6694	...	6½
	17	32709	34203	65417	68406	98126	10.2609	13.0834	13.6812	16.3543	17.1015	19.6251	20.5218	73	
	18	30777	32361	61554	64721	92321	97082	12.3107	12.9443	15.3884	16.1803	18.4661	19.4164	72	
	19	29042	30716	58084	61431	87126	92147	11.6168	12.2862	14.5211	15.3578	17.4253	18.4293	71	
1¾	...	27948	29683	55896	59367	83844	89050	11.1793	11.8733	13.9741	14.8416	16.7689	17.8100	...	6¼
	20	27475	29238	54950	58276	81424	87714	10.9899	11.6952	13.7374	14.6190	16.4849	17.5428	70	
	21	26051	27904	52102	55809	78153	83713	10.4203	11.1617	13.0254	13.9521	15.6305	16.7426	69	
	22	24751	26695	49502	53389	74253	80084	99003	10.6779	12.3754	13.3473	14.8505	16.0168	68	
2	...	24142	26131	48284	52263	72426	78394	96569	10.4525	12.0711	13.0656	14.4853	15.6788	...	6
	23	23559	25593	47117	51186	70676	76779	94234	10.2372	11.7793	12.7965	14.1351	15.3558	67	
	24	24460	24586	44921	49172	67381	73758	89841	98354	11.2302	12.2930	13.4762	14.7516	66	
	25	21445	23662	42890	47324	64335	70986	85780	94648	10.7225	11.8310	12.8670	14.1972	65	
2¼	...	21143	23389	42286	46778	63430	71666	84573	93555	10.5716	11.6944	12.6859	14.0333	...	5¾
	26	20503	22812	41006	45623	61509	68435	82012	91247	10.2515	11.4059	12.3018	13.6870	64	
	27	19626	22027	39252	44054	58878	66081	78504	88108	98131	11.0134	11.7757	13.2161	63	
	28	18807	21301	37615	42601	56422	63902	75229	85202	94036	10.6503	11.2844	12.7803	62	
2½	...	18709	21234	37417	42427	56126	63641	74835	84854	93543	10.6068	11.2252	12.7281	...	5½
	29	18040	20627	36081	41253	54121	61880	72162	82507	90202	10.3133	10.8243	12.3760	61	
	30	17321	20000	34641	40000	51062	60000	69282	80000	86603	10.0000	10.3923	12.0000	60	
	..	16684	19451	33368	38903	50052	58354	66736	77805	83420	97257	10.0110	11.6708	...	
2¾	31	16643	19416	33286	38832	49928	58245	66571	77664	83214	97080	99857	11.6496	59	5¼
	32	16003	18871	32007	37742	48010	56612	64013	75483	80017	94354	96020	11.3225	58	
	33	15399	18361	30797	36722	46196	55082	61595	73443	76993	91804	92362	11.0165	57	
3	..	14996	18000	29993	35999	44989	53998	59984	71998	99980	89998	89976	10.7997	...	5
	34	14826	17883	29651	35766	44477	53649	59302	71532	74128	89415	88954	10.7297	56	
	35	14281	17434	28563	34869	42844	52303	57126	69738	71407	87172	85689	10.4607	55	
	36	13764	17013	27528	34026	41291	51033	55055	68052	68819	85065	82583	10.2078	54	
3¼	...	13483	16787	26967	33574	40450	50361	53934	67160	67417	83935	80901	10.0722	...	4¾
	37	13270	16616	26541	33233	39811	49849	53082	66466	66352	83082	79623	99698	53	
	38	12799	16243	25599	32485	38398	48728	51198	64972	63997	81213	76796	97458	52	
	39	12349	15890	24698	31780	37047	47670	49396	63561	61745	79451	74094	95341	51	
3½	...	12185	15763	24370	31527	36555	47290	48740	63053	60925	78816	73110	94580	...	4½
	40	11918	15557	23835	31114	35753	46672	47670	62229	59588	77786	71505	93343	50	
	41	11504	15243	23007	30485	34511	45728	46015	60970	57518	76213	69022	91455	49	
	42	11106	14945	22212	29890	33318	44834	44425	59779	55531	74724	66637	89669	48	
3¾	...	11033	14891	22067	29781	33100	44672	44133	59562	55167	74454	66000	89344	...	4¼
	43	10724	14663	20447	29326	32171	43988	42895	58651	53618	73314	64342	87977	47	
	44	10355	14396	20711	28791	31066	43187	41421	57582	51777	71978	62132	86373	46	
	45	10000	14142	20000	28284	30000	42426	40000	56569	50000	70711	60000	84853	45	
Pts.	D.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	D.	Pts.
Course		10000		20000		30000		40000		50000		60000		Course	
		Given Diff. of LATITUDE. Course above 45°. — Or Less LEG next an ∠ given above 45°.													

CONSTRUCTION. 1, 2, 3, 4, 5, 6, 7, 8, 9 Times the natural Cotangents and Cosecants, to *Radius* 10000.

COMPUTER N°. III. Continued.

∠		Base.	Hyp.	Base.	Hyp.	Base.	Hyp.	∠	
		Given Departure. Course under 45°.							
Course.		70000		80000		90000		Course.	
Pts.	D	D. Lat.	Dist.	D. Lat.	Dist.	D. Lat.	Dist.	D.	Pts.
	1	401.0297	401.0908	458.3197	458.3894	515.6097	515.6882	89	
	2	200.4538	200.5759	229.0900	229.2296	257.7263	257.8833	88	
¼	...	142.4892	142.6611	162.8448	163.0412	183.2004	183.4214	...	7¾
	3	133.5679	133.7513	152.6491	152.8586	171.7302	171.9659	87	
	4	100.1047	100.3491	114.4053	114.6847	128.7060	129.0202	86	
	5	80.0103	80.3160	91.4404	91.7897	102.8704	103.2634	85	
½	...	71.0724	71.4169	81.2255	81.6194	91.3787	91.8218	...	7½
	6	66.6006	66.9674	76.1149	76.5341	85.6292	86.1009	84	
	7	57.0104	57.4385	65.1548	65.6440	73.2991	73.8495	83	
	8	49.8076	50.2971	56.9230	57.4824	64.0383	64.6677	82	
¾	...	47.1902	47.7066	53.9316	54.5218	60.6701	61.3370	...	7¼
	9	44.1963	44.7472	50.5100	51.1396	56.8238	57.5321	81	
	10	39.6990	40.3114	45.3702	46.0702	51.0415	51.8289	80	
	11	36.0119	36.6859	41.1564	41.9267	46.3010	47.1676	79	
1	...	35.0913	35.8808	40.2187	41.0066	45.2460	46.1330	...	7
	12	32.9324	33.6681	37.6370	38.4779	42.3417	43.2876	78	
	13	30.3203	31.1179	34.6518	35.5633	38.9833	40.0087	77	
	14	28.0755	28.9350	32.0862	33.0685	36.0971	37.2020	76	
1¼	...	27.9456	28.8089	31.9378	32.9245	35.9300	37.0401	...	6¾
	15	26.1244	27.0459	29.8564	30.9096	33.5884	34.7733	75	
	16	24.4119	25.3957	27.8993	29.0236	31.3867	32.6516	74	
1½	...	23.0759	24.1143	26.3724	27.5584	29.6690	31.0041	...	6½
	17	22.8959	23.9421	26.1668	27.3624	29.4377	30.7827	73	
	18	21.5438	22.6525	24.6225	25.8885	27.6992	29.1246	72	
	19	20.3295	21.5009	23.2337	24.5724	26.1379	27.6440	71	
1¾	...	19.5637	20.7783	22.3585	23.7466	25.1533	26.7150	...	6¼
	20	19.2322	20.4666	21.9798	23.3904	24.7273	26.3142	70	
	21	18.2356	19.5330	20.8407	22.3234	23.4458	25.1139	69	
	22	17.3256	18.6863	19.8007	21.3557	22.2758	24.0253	68	
2	...	16.8995	18.2919	19.3137	20.9050	21.7279	23.5181	...	6
	23	16.4910	17.9151	18.8468	20.4744	21.2027	23.0337	67	
	24	15.7223	17.2102	17.9683	19.6687	20.2143	22.1273	66	
	25	15.0115	16.5634	17.1560	18.9296	19.3005	21.2958	65	
2¼	...	14.8003	16.3722	16.9146	18.7110	19.0289	21.0499	...	5¾
	26	14.3521	15.9682	16.4024	18.2494	13.4527	20.5305	64	
	27	13.7383	15.4188	15.7009	17.6215	17.6635	19.8242	63	
	28	13.1651	14.9104	15.0458	17.0404	16.9265	19.170[illegible]	62	
2½	...	13.0961	14.8495	14.9669	16.9708	16.8378	19.0922	...	5½
	29	12.6283	14.4387	14.4324	16.5013	16.2364	18.5640	61	
	30	12.1244	14.0000	13.8564	16.0000	15.5885	18.0000	60	
2¾	...	11.6788	13.6159	13.3472	15.5611	15.0156	17.5062	...	5¼
	31	11.6500	13.5912	13.3142	15.5328	14.9785	17.4744	59	
	32	11.2023	13.2096	12.8027	15.0966	14.4030	16.9837	58	
	33	10.7791	12.8525	12.3189	14.6886	13.8588	16.5247	57	
3	...	10.4972	12.6000	11.9968	14.3996	13.4964	16.1996	...	5
	34	10.3779	12.5180	11.8605	14.3063	13.3439	16.0946	56	
	35	99970	12.2041	11.4252	13.9476	12.8533	15.6910	55	
	36	96347	11.9091	11.0110	13.6104	12.3874	15.3117	54	
3¼	...	94384	11.7509	10.7868	13.4296	12.1351	15.1083	...	4¾
	37	92893	11.6315	10.6164	13.2931	11.9434	14.9548	53	
	38	89596	11.3699	10.2395	12.9942	11.5195	14.6184	52	
	39	86443	11.1231	98792	12.7121	11.1141	14.3013	51	
3½	...	85295	11.0343	97480	12.6106	10.9665	14.1870	...	4½
	40	83423	10.8901	95340	12.4458	10.7258	14.0015	50	
	41	80526	10.6698	92029	12.1940	10.3533	13.7183	49	
	42	77743	10.4613	88849	11.0558	99955	13.4503	48	
3¾	...	77233	10.4235	88266	11.9126	99300	13.4016	...	4¼
	43	75166	10.2640	85789	11.7302	96513	13.1965	47	
	44	72487	10.0769	82842	11.5165	93198	12.9560	46	
	45	70000	98995	80000	11.3137	90000	12.7279	45	
Pts.	D.	Dep.	Dist.	Dep.	Dist.	Dep.	Dist.	D.	Pts.
Course.		70000		80000		90000		Course.	
		Given Dif. Latitude. Course above 45°.							

USE of the Seaman's COMPUTER.

EXAMPLE I. *A Ship's Departure is 54 Miles on a Course of 40° South westerly, required her Difference of Latitude and Distance sailed?*

By the Computer, Number III.

Course.	Dep. W.	D. Lat. S.	Dist.
Agt. 40°	Und. 50	59.588	77.786
	4	4.767	6.222
	Miles 54	64.355	84.008 Answer

EXAMPLE II. *A Ship's Difference of Latitude is 61 Miles North, on a Course North westerly 85°, required her Departure and Distance sailed?*

Course.	Dif. Lat. N.	Dep. W.
Against 85° or 5	60	685.803
	1	11.430
	Miles 61	697.233

Dist.
688.423
11.473

699 896 Answer.

PROPOSITION VI. *To find the Course and Departure from the Distance and Difference of Latitude being given?*

Example. The Distance being 84 Miles, and Difference of Latitude 64.3 Miles, to find the Course and Departure?

First for the Course. RULE. Divide the less by the greater Number, and seek the Decimal Quotient, (about 3 Figures being sufficient) in the Column of Dif. Lat. under 10000, of the *Computer* Number I. even with which, on the Side, stands the *Course*.

Thus, 84)64,3(,765 which *Quote* is found in the said Column against 40° the Course required.

Now, with the given Course and Distance as above find the Departure, by the same *Computer* Number I.

Course.	Dist.	Depart.
Against 40°	Under 80	51.423
	4	2.571
	Miles 84	53.994 or 54

Miles Departure, required

PROPOSITION

USE of the SEAMAN's COMPUTER.

PROPOSITION VII. *To find the Course and Difference of Latitude, from the Distance and Departure given?*

Example. The Distance being 84 Miles, and the Departure 54 Miles, to find the Course and Difference of Latitude?

First for the Course. RULE. Divide the less by the greater Number, and seek the Decimal Quotient (of about 3 Figures) in the Column of Departure under 10000 of the Computer Number I. even with which on the Side stands the Course.

Thus, 84)54(,643 nearly; which *Quote* is found in the said Column against 40°, the Course required.

Now, with the given Course, and Distance, as above, find the Difference of Latitude by the same Computer Number I.

Course.	Dist.	Dif. Lat.
Against 40°	Under 80	61.284
	4	3.064
	Miles 84	64.348 *Dif. Lat.* required

PROPOSITION VIII. *To find the Difference of Longitude from the middle Latitude and Departure being given?*

☞ *The Complement of middle Latitude must be taken as the Course, and the Distance answerable to the given Departure on that Course will be the Difference of Longitude.*

RULE. With the given Departure, at the Top or Bottom of the Computer, (Number II. if the Complement of middle Latitude be ~~less~~ than 45°, but Number III. if ~~greater~~ than 45°) take out the Distance, against the Course (equal to the Complement of middle Latitude) on the Side thereof; and you will have the Difference of Longitude, required.

EXAMPLE I. *Our Ship being Yesterday at Noon in Latitude* 37° 5′ N. *and this Day at Noon in Latitude* 38° 55′ N. *(the middle Latitude being* 38°, *and Complement thereof* 52°*) our Departure* 71 *Miles Westerly, required our Difference of Longitude?*

By Computer Number II. the Complement of middle Latitude being above 45°, *viz.* 52°.

Course.	Depart.	Dist.
Against 52° or 38	Under 70 W.	88.831
	1	1.269
	Miles 71	90.100 Diff. Long. req.

EXAMPLE II. *Our Ship being Yesterday at Noon in Latitude* 46° 9′ N. *and this Day at Noon in* 47° 51′ N. *(the middle Latitude being* 47°, *and Complement thereof* 43°*) our Departure easterly,* 112 *Miles, required the Difference of Longitude?*

By Computer Number III. the Complement of middle Latitude being under 45°, *viz.* 43°.

Course.	Dep. E.	Dist.
Against 43° or 47	Under 100	146,63
	10	16,263
	2	2,932
	Miles 112	165,825 Dif. Long. req.

N. B. If the Complement of middle Latitude is not in whole Degrees, but in Degrees and odd Minutes, you must find the Longitude for the Complement of middle Latitude a Degree less, and greater than the Complement given; adding a proportional Part of the Difference of those Longitudes for the odd Minutes to the Longitude for the less Degree or Complement of middle Latitude, and you will have the Difference of Longitude, required. But the Long. to the *nearest* whole Deg. of Mid. Lat. will be sufficient.

PROPOSITION VIII. *To find the* continual *Course between two Places, and their Distance* on that Course, *from the Latitudes and Longitudes of those Places being given?*

RULE. Find (by *Computer* Number I.) the *Departure* answering a Distance, equal to the Minutes Difference of *Longitude* given; then by the Difference of Latitude given, and the Departure just now found, find the *Course* and *Distance* by PROPOSITION III.

EXAMPLE. The *Lizard* lies in Latitude 49° 50′ N. and 4° 45′ W. Longitude from *Greenwich*; Cape *Finister* in the Latitude of 43° 10′ and 9° 45′ W. Longitude, from *Greenwich*; Required the constant Course, and Distance thereon, between the *Lizard* and Cape *Finister*?

Hence, the Dif. of Latitude is 6° 40′ or 400 Minutes.
Dif. of Longitude 5 0 W. or 300 Minutes.

Middle Latitude 46° 30′
Complement 43 30

By Computer Number I.

Course.	Dist.	Depart.
Against 43°	Under 300	204.60
Against 44	300	208.40
		Dif. 3.80
		Half 1.9 +

Course 43° 30′ Depart. 206.5 Miles.

$$\frac{\text{Dep. } 206.5}{\text{Dif. Lat. } 400} = ,5016;$$ which *Quote*, in Computer II. stands, in Column 10000, against 27° Course S. westerly.

By Computer, Number III.

Course.	Dep. W.	Dist.	Dif. Lat.
Against 27°	Under 200	440.54	392.52
	6	13.21	11.77
	Miles 206	453.75	*404.29

Answer required.

* Here it is *observable* that the Difference of Latitude comes out agreeing (so far as the Nearness of the Course is taken) with the given Difference of Latitude; *a Proof of the Truth of the foregoing Operation.*

And thus all Cases relating to conducting a Ship over the Ocean are readily answered by the *Seaman's Computer* only: being an entire New, easy, and practical METHOD of NAVIGATION.

WITH Regard to the foregoing (VIIIth.) *Propoſition*, the *conſtant* or continued Courſe ſteered by the Ship betwixt two Places, muſt be carefully *diſtinguiſhed* from the *direct Bearing* of one of thoſe Places from the other.

For any Courſe, on the Surface of a Globe, making the ſame conſtant Angle with the ſeveral Meridians, croſſed over by the Ship's Way, is a *ſpiral Track* (of the Logarithmic Kind) which being continued on will terminate in that Pole of the Earth towards which the Ship's Courſe is directed: *Except* when the two Places lie under the ſame *Meridian*, directly North and South, or on the *Equinoctial* directly Eaſt and Weſt of each other, on the Arch of a great Circle.

The *direct Bearing* of any Place from another (generally miſunderſtood for the continued or conſtant Courſe all the Way betwixt thoſe Places) is the *Angle of Poſition* on the Arch of a great Circle, or nearly ſuch, that one Place, on the convex Surface of the Globe, directly bears from the other.

The *conſtant Courſe* that a Ship ſteers betwixt any two Places on the convex Surface, being on a *ſpiral Line*, or nearly ſo, (as before obſerved) is in a *contrary* Direction ſailing back, to what it was in ſailing forward betwixt thoſe Places.

The *direct Bearing* on the Arch of a great Circle marks the *neareſt Diſtance* betwixt any two Places, on the globular Convexity; but this Bearing is continually variable all the Way.

The continually variable Angles in ſailing back are not contrary to thoſe in ſailing forward, betwixt thoſe Places: as is eaſily ſhewn by the Rules of *Spherical Trigonometry*. This has been propoſed as a *Paradox*, by ſome, though an obvious Truth.

THEREFORE this great *Circle Sailing*, in keeping ſo many different Courſes, as muſt be kept in ſailing over the *neareſt Diſtance* betwixt any two Places on the Convexity, is hardly practicable, (eſpecially when thoſe Places lie very remote from each other) becauſe there is not only the Difficulty to overcome, in computing all the Variety of Courſes neceſſary to be ſteered, but the Difficulty of putting them in Practice againſt all Impediments or Accidents whatſoever, of Winds and Weather, that may conſpire to prevent it.

Nor can *elliptical Sailing*, by the Arch of an Ellipſis on the Ellipſoid, or flatted Globe next the Poles, be better put in Practice, for ſailing the *neareſt Diſtance* betwixt any two Places, on Account of the like Obſtacles, that may prevent that Kind of Sailing taking ſo *complicated* an Effect.

Therefore practical or *ſpiral Sailing*, or that which has long been in Uſe, and lately improved, according to ſome conſtant Courſe and Diſtance run on that Courſe, or other *Things given* for finding the *Requiſites*, as near the Truth as poſſible, is here laid down and exemplified, in all the Variety of Caſes that can happen, for the Purpoſe of the *Practical Navigator*.

After we have conſidered, from our own Experience, (in ſeveral Voyages at Sea) the many Impediments to putting *the true Theory of Navigation* in Practice, with all the Advantages to Geography, from the late Diſcoveries made of the *true Figure* and *Dimenſions* of the Earth as a *Spheroid*, (by the Meaſure of a Degree of the Earth's Meridian in *Peru* and *Lapland*) we would no Ways depreciate thoſe *Experiments*, as lately publiſhed by Mr. *Martin*, in his *Folio* Work, (intitled NEW PRINCIPLES of GEOGRAPHY and NAVIGATION) ſo far as they have *real* Uſe and Advantage.

And as that AUTHOR ſays with Regard to the *Theory itſelf*, "The beſt Way of ſetting *Falſhood* and *Error* "in a proper Light, is to compare and confront them with *Truth*," (the Truth of the *ſpheroidal Theory* being admitted, however falſe the *Spheroid* given) ſo in Regard to putting ſuch *Theory into Practice* with its *ſuperior Advantages* to *Mercator*'s and other Sailing, heretofore in Uſe, will beſt appear by comparing *Examples*, computed according to ſpheroidal and other Methods of *Navigation*.

☞ The *Error* ariſing from the *Diſtance* (meaſured by the *Log*) and *Courſe* (ſteered by the *Compaſs*) being ſo doubtfully aſcertained, will be always of far greater Concern to the *Truth* of a Ship's Reckoning than the *Difference* between *ſpherical* and *ſpheroidal Navigation*. —— Till which *Courſe* and *Diſtance* can be more correctly aſcertained, the ſmaller Correction in *Theory* will have (as we apprehend) but a very ſmall Uſe in the *Nearneſs of Practice*. And all the Correction that can be expected of Advantage muſt *chiefly* ariſe from a *correct Obſervation* of the Sun, or other cœleſtial Bodies, for aſcertaining the true *Latitude* and *Longitude* of the Ship.

See all Mr. *Martin's Examples of Spheroidal Sailing following, anſwered by our* Seaman's Computer, (without Scale, Compaſſes, Chart, or Canon) *and compared with the Anſwers by* Mercator'*s Sailing*.

OUR

OUR NEW METHOD of *Computation* (*without* Scale, Compaſſes, Chart, *or* Canon) exemplified in *Anſwers* to the Five CASES of SAILING, as propoſed by Mr. *MARTIN* in his NEW PRINCIPLES of NAVIGATION, according to ſailing by the SPHEROID; confronted and compared with the ANSWERS to thoſe CASES, according to MERCATOR-SAILING, by the SPHERE. With REMARKS and INFERENCES drawn on theſe different METHODS of SAILING.

I. CASE. *To find the Courſe and Diſtance run, from the Difference of Latitude and Longitude, given?*

Example. A Ship ſails from a Port in Latitude 38°, and arrives at another Port in Latitude 5°, and finds her *Difference* of Longitude to be 43°; required from thence her *Courſe* and *Diſtance* ſailed?

By *Tables*, P. 290, 288.

Latitude.	*Spheroidal.* Mer. Parts.	*Spherical.* Mer. Parts.
Under 38°	2452	2468
5	298	300
Dif. 33° = 1980′	2154 Mer. Dif. Lat.	2168 Mer. Dif. Lat.

By *Computer* N°. III.

	Courſe	Dif. Lat.	Diſt. run.
NOW, againſt	50°	1000	1555,72
		900	1400,15
		80	124,46
By *Mercator* . .		1980	3080,33
By *Spheroidal Sailing* . .			3071, from below.

9′ Diff. in ſailing 33° Dif. Lat.
[whereas a ſmall Error in the Courſe will cauſe a vaſtly greater Diff. in the *Diſtance*.

Dif. Longitude 43° = 2580′

Firſt, $\frac{2154}{2580}$ = ,8349, againſt which, under Col. 10000 Computer N°. II. ſtands 50°, 8′ the *Courſe*; (the Dif. Longitude being more than the Dif. Latitude.) } according to *ſpheroidal* Sailing.

Or, $\frac{2168}{2580}$ = ,8402 . . Againſt which under Col. 10000 ſame *Computer*, ſtands 49° 58′, or nearly 50° *Courſe*. } according to *Mercator*-Sailing.

☞ *This* CASE *is now reduced to one of plain Sailing, the Courſe and Difference of Latitude given to find the Diſtance run?*

By *Table* P. 294.

Lat.	Length of Arcs.
38°	2266′,35
5	297 ,76
33°	1968′,59 true Dif. Lat. by the [*ſpheroidal* Figure of the Earth.

By Computer N°. III.

	Courſe.	Dif. Lat.	Diſtance run.
Againſt	50°	1000	1555,72
		900	1400,15
		60	93,34
		9	14,00
		1969	3063,21
According to Mr. *Martin*'s Navigation, p. 52. The *Courſe* being	50°. 8′ . . .	1968,6	3071.
			Dif. 7′,79, or about [8′ only.

REMARK. *Since no Ship can ſteer to 8′, or nearer than to 1°, in her Courſe*; therefore OUR COMPUTERS N°. I. II. III. for each Degree of *Courſe*, are *ſufficiently* exact for the *practical Purpoſe* of Navigation, according to *Plain, Middle-Latitude, Mercator*, or *Spheroidal Sailing*. For the *Error* in the *Ship's Reckoning*, occaſioned by the *Courſe*, and Diſtance run, that cannot be kept or determined to *Exactneſs*, or hardly to a *Nearneſs*, will *always* be *conſiderably greater* than the *Error* or *Difference*, ariſing from the DIFFERENT METHODS of SAILING, whether by *old* or *new Principles*.

INFERENCE. That unleſs *Improvement* can be made in keeping the *Courſe*, and meaſuring the *Diſtance* run, to a greater Exactneſs than has been hitherto *practicable*, or known by Navigators, the *minuter Improvement* of *ſpheroidal Navigation* will be ſo far an *idle Refinement*, (as obſerved by Mr. *Emerſon* in the Preface to his Naviga-

SPHERICAL and SPHEROIDAL NAVIGATION compared.

tion) that it will be a *fruitleſs* and vain Attempt. For, ſince the *Courſe* ſteered, and *Diſtance* run, by the Ship, are generally *precarious*, and largely different (*more* or *leſs*) from Truth, the Correction of the *leſs Error*, from the Difference between the ſpherical and true Figure of the Earth, will be of no Advantage to the *Ship's Reckoning*, for long Runs, ſince the larger Error, from the Courſe and Diſtance ſailed, will be as often *encreaſed* thereby as diminiſhed. For which Reaſon this ſmall Correction may ſometimes prove an *Ignis fatuus*, in long Runs, inſtead of a *Taper*, to guide the Mariner. Beſides a *Ship's Reckoning*, kept from Day to Day, by *Mercator*, or *Spheroidal* Sailing, will have an inſignificant or inſenſible *Difference* in Practice; ſince the Difference of meridional Parts, of both Kinds, for a *ſhort Run*, are *nearly* the ſame.

Therefore, all Improvement of *real* Advantage in Navigation *chiefly* conſiſts in Correction of the *Ship's Place*, by *aſtronomical Obſervation*, or in ſome Method, to determine thereby the *Longitude*, as well as *Latitude*, of the Ship; to be applied with the *common Methods* of Navigation in Practice.

But, we have given the *meridional Parts* of the Earth as a *Spheroid*, in a Table following, *confronted* with another Table of the *meridional Parts* of the Earth as a *Sphere*, for the *Navigator's Curioſity and Satisfaction*. Who may thereby make *Trial* of either, and their Difference, in computing the *Ship's Place*, as we have here exemplified, or put in Practice, for his Uſe, in *long Runs*; which ſeldom or never happen in PRACTICAL NAVIGATION.

Therefore Mr. *Murdoch*, and Mr. *Martin* after him, having exemplified *ſpheroidal* (or ſpeculative) *Navigation*, in long Runs, *by Caſes never happening in Practice*, have thereby concealed the INUTILITY OF THAT DOCTRINE (except to *Geography*) as much as poſſible.

II. CASE. *To find the Difference of* LONGITUDE *and* DISTANCE *ſailed from the Difference of* LATITUDE *and* COURSE *given?*

Example. A Ship ſails from a Place in 25° *North Latitude* to another in 30° of *South Latitude*, upon a *Courſe* of 43°, to find the Difference of *Longitude* and *Diſtance ſailed?*

By *Tables*, P. 289, 290.

Lat.	*Spheroidal.* Mer. Parts.	*Spherical.* Mer. Parts.
Under 25°	1539	1550
30	1875	1888
Dif. Lat. *Sum* 55° = 3300′	3414	3438

By *Computer* N°. II.

Courſe.	Mer. Dif. Lat.	Dif. Long. for Depart.	
Againſt 43°	3000	2797,50	*According to the Spheroid.*
	400	373,01	
	10	9,32	
	4	3,73	
	3414	3183,56 = 53° 4′ *Dif. Longitude.*	

By Mr. *Martin*'s Navigation, P. 53. . . . 3184′,1 = 53° 4′.

		Length of Arcs.
By *Tab.* P. 294.	25°	1489,79
	30	1788,26
	55°	3278′,05 true Dif. Lat. by the ſpheroidal Figure of the Earth.

By our *Computer*, N°. II.

Againſt 43°	3000	2797,50	According to the Sphere, or Mercator-Sailing.
	400	373,01	
	30	27,97	
	8	7,46	
	3438	3205,94 = 53° 26′ Dif. Long.	

Now, To find the Diſtance run from the true Difference of Latitude 3278′, *or from the common Difference* 3300′ *given; a plain-ſailing Caſe.*

By *Computer*, Number II.

Courſe.	Dif. Lat.	Diſt.	
Againſt 43°	3000	4102,00	
	200	273,46	
	70	95,71	
	8	10,94	
	3278	4482,11	Diſt. run
By Mr. *Martin*'s Navigation, P. 53. . . .		4482,11 by the Spheroid.	

Or, Againſt 43°	Dif. Lat.	Diſt.	
	3000	4102,00	
	300	410,20	
	3300	4512,20	Diſtance run by com. *Method.*
		4482,11	by Spheroid.
		But 30′,09 Dif. Diſt. in ſailing 55° Dif. Latitude.	

SPHERICAL and SPHEROIDAL NAVIGATION compared.

III. CASE. *To find the Difference of* LONGITUDE *and the* COURSE, *from the Difference of* LATITUDE *and* DISTANCE *failed, being given?*

Example. A Ship failed from the Latitude 25° North, to Latitude 30° South, and her Diſtance failed meaſured 4482,1 Miles, as in the foregoing Example, to find the *Courſe* and Difference of *Longitude?*

Given, $\frac{3278 \text{ Miles Dif. Lat.}}{4482,1 \text{ Diſt. run}}$ = ,7313, and ſtands in Computer, N°. I. in Col. 10000, againſt 43° *Courſe*, req^{d}.

Meridional Dif. Long. 3414 (Spheroid), or 3438 (Sphere), found before.

By Computer, N°. III.

Courſe.	Spheroidal Mer. Parts.	Dif. Long. for Dep.	
Againſt 43°	3000	2797.5	According to Spheroidal Sailing.
	400	373.01	
	10	9.325	
	4	3.730	
	3414	3183.565	

Courſe.	Spherical Mer. Parts.	Dif. Long. for Dep.
Againſt 43°	3000	2797.50
	400	373.01
	30	27.97
	8	7.46
	3438	3205.94

By Mr. *Martin*'s Nav. P. 54. 3184.1 = 53° 4′ Dif. Long. as before.

.5 Diff.

owing to the ſpheroidal meridional Parts, being taken 3414, inſtead of 3414,6.

= 53° 26′ Dif. Long. as before.

IV. CASE. *To find the Difference of* LATITUDE *and* DISTANCE *run, from the* COURSE *and Difference of* LONGITUDE, *given?*

Example. A Ship fails from a *Port* in Latitude 51° 15′, ſteering a Courſe of 35° 30′ with the Meridian, till ſhe finds her Difference of *Longitude* 28° 30′ = 1710 *Miles*, to find her Difference of *Latitude* and Diſtance run?

By *Computer*, Number III.

Courſe.	Dif. Long. for Dep.	Mer. Parts.
35° 30′	1000	1402,2
	700	981,58
	10	14,02
	1710	2397,80 Mer. Parts of Dif. of Lat.

	Lat.	Spheroid. Mer. Parts.	Spheric Mer. Parts.
Now,	51° 15′	3572,5	3592,5
	Subtract	2397,8	2397,8
		1174,7	1194,7
Mer. Parts of Lat. arrived in		= 19° 21′	= 19° 31′ Latitude required.
Martin's Navigation, P. 54.		19 · 21	Same.

N. B. *If Merid. Parts of the Dif. of Lat. are greater than the Mer. Parts of the Lat. given, you muſt deduct the latter from the former, and the Remainder will anſwer to the Lat. on the contrary Side of the Equator.*

How ſmall the Difference by *ſpheroidal* and Mercator-Sailing, in 31° 54′ or 31° 44′ Dif. Latitude.

If the Latitude had been 22° 40′ (inſtead of 51° 15′)

Spheroid. *Meridional* Parts =	1387		Spheric. *Meridional* Parts =	1397
	2398			2398
Anſwering to Latitude 16° 44′ S.	1011 Dif.		Lat. 16° 27′ S.	1001 Dif.
22 40			22 40	
Dif. Lat. 39 24 *Spheroidal* Sailing.			Dif. Lat. 39 7 *Spherical* Sailing.	

☞ How ſmall the Difference, only 17′, *Refinement*, in failing *betwixt ſo diſtant a Parallel:* and therefore what will be the Odds betwixt ſpheroidal and Mercator Sailing for daily Reckonings?

SPHERICAL and SPHEROIDAL NAVIGATION compared.

NOW to *find the Distance sailed* from the Course and Difference of *Latitude* given; being a Case of *plain-Sailing?*

	Lat.	Length Arcs		Egregious Error!	
By Tab. P. 294.	51° 15′	3059.81	*In Mr.* Martin's *Navigation the Arcs are erroneously given, as follow*	2999.85	*Confronted with Truth on the Left.*
	19 21	1152.91		1271.2	
	31 54	1906.90		1728 65	
	= 19 14′	about 1907′	Which *Author* has taken out for	50° 15′ / 21 20	instead of for 51° 15′ / 19 21

By *Computer*, Number II.

Course.	Dif. Lat.	Dist.	
Against 35° 30′	1000	1228.42	
	900	1105.58	
	7	8.59	
	1907	2342.59	Dist. run.
By Mr. *Martin*'s Nav. P. 55.		2123.	
		219.57 +	Error of Mr. *Martin*'s Navigation.

By same *Computer*, Number II.

Course.	Dif. Lat.	Dist.
Or, Against 35° 30′	1000	1228.42
	900	1105.58
	10	12.28
	4	4.91
	1914	2351,19

V. CASE. *To find the Difference of* LATITUDE *and Difference of* LONGITUDE *from the Course and Distance run, being given?*

☞ THIS is the most frequent and useful Case occurring in Navigation, though considered and introduced last of all by the Author of *New Principles of Geography and Navigation*, whose Questions are proposed all along (like the *Reverend* Mr. *Murdoch*'s, the *original* Proprietor of this *new Improvement)* quite *out of Practice*, or such as never occur in *practical Sailing*. — So that if Questions in this *new Method*, had been proposed to work Traverses, or a *Ship's daily Reckoning*, as is the chief Business of Navigators, *(instead of working thousand Mile Runs)* the IDLE REFINEMENT *of this new Navigation* (observed by so able a Judge as Mr. EMERSON) *would appear obvious to the* meanest Capacity in Science. And no other Advantage can arise from considering the Earth as a Spheroid but to *Geography, Map-making*, and small Correction of *cælestial Observation:* The Advantage thereof to Navigation plainly appearing to be none. Therefore, in Imitation of Mr. *Emerson*, whose Judgment and Method in all he writes is *exemplary*, we have given *superior Place* to the meridional Parts of the SPHERE, as being very sufficient for all the Purposes of *practical Navigation:* at the same Time they correspond with the *charming Elegance* and *correct Solution* of all Questions of Spherical NAVIGATION, by the *Logarithm-Tangents* of the half Complements of Latitudes, as demonstrated and exemplified by the late famous Dr. HALLEY, in *Philos. Transact.* Number 219.

Example to the foregoing Case. A Ship runs 4482,1 Miles upon a *Course* of 43° from the Meridian, *Southward*, from a *Port* lying in Latitude 25° N. to determine from thence her Difference of *Latitude* and *Longitude?*

FIRST *for the Difference of Latitude, by Computer* Number I.

Course.	Dist.	Dif. Lat.	
Against 43°	4000	2925.4	*Being a Case of* PLAIN-SAILING.
	400	292.54	
	80	58.51	
	2	1.46	
	.1	.07	
	4482.1	3277.98 Dif. Lat.	
By Mr. *Martin*'s Navigation, P. 55. . . .		3278.	Dif. Lat. according to his *new Principles* of Navigation.

Deduct the Length of the Arc 25°, by Tab. P. 294.	1489.79	Or 3278′ — 1500 = 25°
Remaining Arc on other Side of the Equator = 30° + 25	1788.21	1778 = 29 38′

Dif. Lat. . . 55° required. Or $\frac{3278}{60} = 54°\ 38'$ Dif. Lat. *without Refinement.*

NOW

SPHERICAL and SPHEROIDAL NAVIGATION compared.

NOW *to find the Difference of Longitude, from the Course* 43°, *and Difference of Latitude* 55° *(or* 54° 38′*) being given?*

	Lat.	Spheroid. Mer. Parts.	Spheric. Mer. Parts.
By Tab. P. 289, 290.	25° N.	1539	1550
	30 S.	1875	1888
Sum	55° D. Lat.	3414 Mer. D. Lat.	3438 Mer. D. Lat.

By *Computer*, Number II.

Course.	Mer. D. Lat.	Dif. Lon. for Dep.	
Against 43°	3000	2797.50	*According to spheroidal Sailing* = 53° 4′ Longitude required.
	400	373.01	
	10	9.32	
	4	3.73	
	3414	3183.56	

Mr. *Martin's Navigation*, P. 55. . . . 3184.

	Lat.	Spheric. Mer. Parts	Course.	Merid. D. Lat.	Dif. Long. for Dep.
By Tab. P. 289	25° N.	1550	43°	3000	2797.50
	29 38 S.	1863		400	373.01
				10	9.32
Sum	54 38	3413		3	2.79
					3182.62

☞ How near this Answer = 53° 3′ to the refined Answer in Mr. Martin's *Navigation, and yet* this *Nearness is found by meridional Parts of the Sphere.*

Course.	Merid. Dif. Lat.	D. Long. for Dep.	
43°	3000	2797.50	*According to Mercator Sailing.*
	400	373.01	
	30	27.97	
	8	7.46	
	3438	3205.94	

[= 53° 26′ Dif. Long. req^d.

FROM *what is exemplified in the foregoing Pages, it may be observed, that* our COMPUTERS, N°. I. II. III. *equally serve for all the* METHODS OF NAVIGATION. *And that when Longitude is concerned, the meridional Difference of Latitude must be used instead of common Difference of Latitude, used in Cases of Plain Sailing. The only Difference between plain and Mercator, or even spheroidal, Sailing, is in two similar plain Triangles: the plain-sailing Triangle being contained in the Mercator-sailing Triangle. The plain-sailing triangular Leg, opposite to the Course, measuring what is called* Departure; *and the Mercator triangular Leg, opposite to the same Course, measuring the Longitude, in the Equator, or on the contrary Side thereof, to the first Place of given Latitude, sailed from.*

☞ FOR Satisfaction of the *Proportion* of the *Lines* on the convex-Surface of the Earth, as a *Sphere*, used in the *different Methods* of *Navigation*, and also the Properties of *plain* and *spherical* Triangles, see *further on*.

We have also shewn, further on, the Error of Mr. *B. Martin*'s METHOD, in his *New Principles* of *Geography and Navigation*, of finding the *Dimensions* of the Earth as an *oblate Spheroid*, who makes Use of an *incorrect* Radius of Curvature (for solving those several Problems) determined by supposing the Earth a *correct Sphere*, and then draws his Conclusions relating to the Properties of the *spheroidal Form* of the Earth. We have shewn the Insufficiency of his Method by *several Examples* confronted with the *Result* of M. *Maupertuis*' (coinciding with Don *Juan*'s) Method of determining the *Ratio* of the Earth's Diameters, from the Measure of a Degree of Latitude on the *elliptic* Meridian, at different and remote Places; in *Lapland*, *France*, and the at *Equator*.

Upon the whole of which it appears, that the Spheroid followed by *B. Martin*'s *New Chart*, according to *Maupertuis* and *Murdoch*, is *twice* as much from the *true Spheroid* as that is from the *Sphere*. So that if Don *Juan*'s Spheroid (of Diameters 266 to 265) is true, *Murdoch*'s or *Martin*'s Chart-Navigation are *doubly erroneous* compared with the Navigation of the *Sphere*.

Hence it follows that Mr. *B. Martin* has *depreciated* Mr. EMERSON's Judgment and *Spherical Navigation*, without Reason, or answering Mr. *E*'s Reasons given. Who, with as much Reason, might *depreciate* the *Globes*, *Spectacles*, *Vision-Glasses*, and *Mathematical Instruments* not sold by Himself, while he boasts the *Invention* or *Improvement* of his own. Yet we are informed that *Senex*'s Globes were first sold to *Ferguson* and then to Him. And that *Globes*, *Spectacles*, *Vision-Glasses*, and *Mathematical Instruments* sold by Mr. *Cole*, *Cuff*, and others in *Fleetstreet*, are really as perfect as those sold by *B. Martin*.

MERIDIONAL PARTS on *Mercator's* CHART, correfponding with the Earth's Convex Surface of a Sphere.

Degrees of LATITUDE.

′	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	′
0	0	60	120	180	240	300	361	421	481	542	603	664	725	787	848	0
2	2	62	122	182	242	302	363	423	483	544	605	666	727	789	850	2
4	4	64	124	184	244	304	365	425	485	546	607	668	729	791	852	4
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	855	6
8	8	68	128	188	248	308	369	429	490	550	611	672	733	795	857	8
10	10	70	130	190	250	310	371	431	492	552	613	674	735	797	859	10
12	12	72	132	192	252	312	373	433	494	554	615	676	737	799	861	12
14	14	74	134	194	254	314	375	435	496	556	617	678	740	801	863	14
16	16	76	136	196	256	316	377	437	498	558	619	680	742	803	865	16
18	18	78	138	198	258	318	379	439	500	560	621	682	744	805	867	18
20	20	80	140	200	260	320	381	441	502	562	623	684	746	807	869	20
22	22	82	142	202	262	322	383	443	504	564	625	686	748	809	871	22
24	24	84	144	204	264	324	385	445	506	566	627	688	750	811	873	24
26	26	86	146	206	266	326	387	447	508	568	629	690	752	813	875	26
28	28	88	148	208	268	328	389	449	510	570	631	692	754	815	877	28
30	30	90	150	210	270	330	391	451	512	573	633	695	756	817	879	30
32	32	92	152	212	272	332	393	453	514	575	635	697	758	820	881	32
34	34	94	154	214	274	334	395	455	516	577	638	699	760	822	883	34
36	36	96	156	216	276	336	397	457	518	579	640	701	762	824	886	36
38	38	98	158	218	278	338	399	459	520	581	642	703	764	826	888	38
40	40	100	160	220	280	340	401	461	522	583	644	705	766	828	890	40
42	42	102	162	222	282	342	403	463	524	585	646	707	768	830	892	42
44	44	104	164	224	284	344	405	465	526	587	648	709	770	832	894	44
46	46	106	166	226	286	346	407	467	528	589	650	711	772	834	896	46
48	48	108	168	228	288	348	409	469	530	591	652	713	774	836	898	48
50	50	110	170	230	290	350	411	471	532	593	654	715	776	838	900	50
52	52	112	172	232	292	352	413	473	534	595	656	717	778	840	902	52
54	54	114	174	234	294	354	415	475	536	597	658	719	781	842	904	54
56	56	116	176	236	296	356	417	477	538	599	660	721	783	844	906	56
58	58	118	178	238	298	358	419	479	540	601	662	723	785	846	908	58
60	60	120	180	240	300	361	421	481	542	603	664	725	787	848	910	60

MERIDIONAL PARTS on a CHART, correfponding with the Earth's Convex Surface of a Spheroid. Diameters 266 to 265.

Degrees of LATITUDE.

′	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	′
0	0	60	119	179	238	298	358	418	478	538	599	659	720	781	842	0
2	2	62	121	181	240	300	360	420	480	540	601	661	722	783	844	2
4	4	64	123	183	242	302	362	422	482	542	603	663	724	785	846	4
6	6	66	125	185	244	304	364	424	484	544	605	665	726	787	848	6
8	8	68	127	187	246	306	366	426	486	546	607	667	728	789	850	8
10	10	70	129	189	448	308	368	428	488	548	609	669	730	791	852	10
12	12	72	131	191	250	310	370	430	490	550	611	671	732	793	854	12
14	14	74	133	193	252	312	372	432	492	552	613	673	734	795	857	14
16	16	75	135	195	254	314	374	434	494	554	615	675	736	797	859	16
18	18	77	137	197	256	316	376	436	496	556	617	677	738	799	861	18
20	20	79	139	199	258	318	378	438	498	558	619	679	740	801	863	20
22	22	81	141	201	260	320	380	440	500	560	621	681	742	803	865	22
24	24	83	143	203	262	322	382	442	502	562	623	683	744	805	867	24
26	26	85	145	205	264	324	384	444	504	564	625	685	746	807	869	26
28	28	87	147	207	266	326	386	446	506	566	627	687	748	809	871	28
30	30	89	149	209	268	328	388	448	508	568	629	689	750	812	873	30
32	32	91	151	210	270	330	390	450	510	570	631	692	752	814	875	32
34	34	93	153	212	272	332	392	452	512	572	633	694	754	116	877	34
36	36	95	155	214	274	334	394	454	514	574	635	696	756	818	879	36
38	38	97	157	216	276	336	396	456	516	576	637	698	759	820	881	38
40	40	99	159	218	278	338	398	458	518	578	639	700	761	822	883	40
42	42	101	161	220	280	340	400	460	520	580	641	702	763	824	885	42
44	44	103	163	222	282	342	402	462	522	582	643	704	765	826	887	44
46	46	105	165	224	284	344	404	464	524	584	645	706	767	828	889	46
48	48	107	167	226	286	346	406	466	526	586	647	708	769	830	891	48
50	50	109	169	228	288	348	408	468	528	588	649	710	771	832	893	50
52	52	111	171	230	290	350	410	470	530	590	651	712	773	834	896	52
54	54	113	173	232	292	352	412	472	532	592	653	714	775	836	898	54
56	56	115	175	234	294	354	414	474	534	595	655	716	777	838	900	56
58	58	117	177	236	296	356	416	476	536	597	657	718	779	840	902	58
60	60	119	179	238	298	358	418	478	538	599	659	720	781	842	904	60

CONSTRUCTION. *For the Meridional Parts of the Sphere.* RULE. *Multiply the Tabular Logarithm Tangent* (according to *Brigg's* Form) *of the Sum of Half the Degrees of Latitude and* 45°, *by the* conftant *Number* 7915,7, *or* 7916, *and the* Product *will be the Meridional Parts for the given Latitude, when the Form of the Earth is confidered as a perfect Sphere.*

EXAMPLE. To find the Meridional Parts of the Sphere, for the Latitude of 60°?

30° + 45° = 75°, whofe Logarithm Tangent = ,5719475 = Log. Rad. — Log. 15°.

Or Log. Radius Minus Log. Tangent of half the Complement of Latitude multiplied by 7916 will give the Meridian Parts for the Sphere } by 7915,7

Product = 4527,364 or 4527 Meridional Parts required.

MERIDIONAL

MERIDIONAL PARTS on *Mercator*'s CHART, corresponding with the Earth's Convex Surface of a Sphere.

Degrees of LATITUDE.

′	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	′
0	910	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1684	1751	1820	0
2	912	975	1037	1100	1163	1227	1291	1356	1421	1486	1552	1619	1686	1753	1822	2
4	914	977	1039	1102	1166	1229	1293	1358	1423	1488	1554	1621	1688	1756	1824	4
6	917	979	1041	1104	1168	1231	1296	1360	1425	1491	1557	1623	1690	1758	1826	6
8	919	981	1044	1107	1170	1234	1298	1362	1427	1493	1559	1625	1692	1760	1828	8
10	921	983	1046	1109	1172	1236	1300	1364	1429	1495	1561	1628	1695	1762	1831	10
12	923	985	1048	1111	1174	1238	1302	1367	1431	1497	1563	1630	1697	1765	1833	12
14	925	987	1050	1113	1176	1240	1304	1369	1434	1499	1565	1632	1699	1767	1835	14
16	927	989	1052	1115	1178	1242	1306	1371	1436	1501	1568	1634	1701	1769	1838	16
18	929	991	1054	1117	1180	1244	1308	1373	1438	1504	1570	1636	1704	1771	1840	18
20	931	993	1056	1119	1183	1246	1311	1375	1440	1506	1572	1639	1706	1774	1842	20
22	933	996	1058	1121	1185	1248	1313	1377	1442	1508	1574	1641	1708	1776	1845	22
24	935	998	1060	1123	1187	1251	1315	1379	1445	1510	1576	1643	1710	1778	1847	24
26	937	1000	1062	1125	1189	1253	1317	1382	1447	1512	1579	1645	1713	1781	1849	26
28	939	1002	1064	1128	1191	1255	1319	1384	1449	1515	1581	1648	1715	1783	1851	28
30	941	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	1717	1785	1854	30
32	944	1006	1069	1132	1195	1259	1323	1388	1453	1519	1585	1652	1719	1787	1856	32
34	946	1008	1071	1134	1197	1261	1326	1390	1456	1521	1587	1654	1722	1790	1858	34
36	948	1010	1073	1136	1200	1263	1328	1392	1458	1523	1590	1657	1724	1792	1861	36
38	950	1012	1075	1138	1202	1266	1330	1395	1460	1526	1592	1659	1726	1794	1863	38
40	952	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	1728	1797	1865	40
42	954	1016	1079	1142	1206	1270	1334	1399	1464	1530	1596	1663	1731	1799	1868	42
44	956	1018	1081	1144	1208	1272	1336	1401	1466	1532	1599	1665	1733	1801	1870	44
46	958	1021	1083	1147	1210	1274	1338	1403	1469	1534	1601	1668	1735	1803	1872	46
48	960	1023	1085	1149	1212	1276	1341	1405	1471	1537	1603	1670	1737	1806	1874	48
50	962	1025	1088	1151	1214	1278	1343	1408	1473	1539	1605	1672	1740	1808	1877	50
52	964	1027	1090	1153	1216	1281	1345	1410	1475	1541	1607	1674	1742	1810	1879	52
54	966	1029	1092	1155	1219	1283	1347	1412	1477	1543	1610	1677	1744	1812	1881	54
56	968	1031	1094	1157	1221	1285	1349	1414	1480	1545	1612	1679	1747	1815	1884	56
58	971	1033	1096	1159	1223	1287	1351	1416	1482	1548	1614	1681	1749	1817	1886	58
60	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1684	1751	1820	1888	60

MERIDIONAL PARTS on a CHART, corresponding with the Earth's Convex Surface of a Spheroid. Diameters 266 to 265.

Degrees of LATITUDE.

′	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	′
0	904	966	1028	1090	1153	1216	1280	1344	1408	1473	1539	1605	1672	1739	1807	0
2	906	968	1030	1092	1155	1218	1282	1346	1411	1476	1541	1607	1674	1741	1809	2
4	908	970	1032	1094	1157	1220	1284	1348	1413	1478	1543	1610	1676	1743	1811	4
6	910	972	1034	1096	1159	1223	1286	1350	1415	1480	1546	1612	1678	1746	1814	6
8	912	974	1036	1099	1161	1225	1288	1353	1417	1482	1548	1614	1681	1748	1816	8
10	914	976	1038	1101	1164	1227	1291	1355	1419	1484	1550	1616	1683	1750	1818	10
12	916	978	1040	1103	1166	1229	1293	1357	1421	1487	1552	1618	1685	1753	1821	12
14	918	980	1042	1105	1168	1231	1295	1359	1424	1489	1554	1621	1687	1755	1823	14
16	920	982	1044	1107	1170	1233	1297	1361	1426	1491	1557	1623	1690	1757	1825	16
18	922	984	1046	1109	1172	1235	1299	1363	1428	1493	1559	1625	1692	1759	1827	18
20	924	986	1048	1111	1174	1237	1301	1365	1430	1495	1561	1627	1694	1762	1830	20
22	926	988	1051	1113	1176	1240	1303	1368	1432	1497	1563	1629	1696	1764	1832	22
24	928	990	1053	1115	1178	1242	1305	1370	1434	1500	1565	1632	1699	1766	1834	24
26	930	992	1055	1117	1180	1244	1308	1372	1437	1502	1568	1634	1701	1768	1836	26
28	933	995	1057	1119	1182	1246	1310	1374	1439	1504	1570	1636	1703	1771	1839	28
30	935	997	1059	1122	1185	1248	1312	1376	1441	1506	1572	1638	1705	1773	1841	30
32	937	999	1061	1124	1187	1250	1314	1378	1443	1508	1574	1641	1708	1775	1843	32
34	939	1001	1063	1126	1189	1252	1316	1380	1445	1511	1576	1643	1710	1777	1846	34
36	941	1003	1065	1128	1191	1254	1318	1383	1447	1513	1579	1645	1712	1780	1848	36
38	943	1005	1067	1130	1193	1257	1320	1385	1450	1515	1581	1647	1714	1782	1850	38
40	945	1007	1069	1132	1195	1259	1323	1387	1452	1517	1583	1649	1717	1784	1852	40
42	947	1009	1071	1134	1197	1261	1325	1389	1454	1519	1585	1652	1719	1786	1855	42
44	949	1011	1073	1136	1199	1263	1327	1391	1456	1522	1587	1654	1721	1789	1857	44
46	951	1013	1076	1138	1201	1265	1329	1393	1458	1524	1590	1656	1723	1791	1859	46
48	953	1015	1078	1140	1204	1267	1331	1396	1460	1526	1592	1658	1725	1793	1862	48
50	955	1017	1080	1143	1206	1269	1333	1398	1463	1528	1594	1661	1728	1796	1864	50
52	957	1019	1082	1145	1208	1271	1335	1400	1465	1530	1596	1663	1730	1798	1866	52
54	959	1021	1084	1147	1210	1274	1338	1402	1467	1532	1598	1665	1732	1800	1869	54
56	961	1024	1086	1149	1212	1276	1340	1404	1469	1535	1601	1667	1734	1802	1871	56
58	963	1026	1088	1151	1214	1278	1342	1406	1471	1537	1603	1670	1737	1805	1873	58
60	966	1028	1090	1153	1216	1280	1344	1408	1473	1539	1605	1672	1739	1807	1875	60

CONSTRUCTION. *For the Meridional Parts of the* Spheroid. RULE. Multiply the natural Sine of the Latitude (to Radius 1) by the *Focal Distance* from the Center of the Ellipsis, in Parts of 1, the Semi-Transverse, and the *Product* will be the natural Sine of an Arc. The Logarithm Tangent of the Half Complement of which Arc to 90°, being multiplied by the *Product* of the said *Focal Distance* and *constant* Number 7915,7, the LAST PRODUCT will be the *Difference* less between the Meridional Parts of the *Sphere* and *Spheroid* for the same Latitude.

EXAMPLE. To *find the Meridional Parts of the oblate Spheroid, or flatted Sphere, for Latitude* 60°; *the Semi-Diameter of the Equator t. the Semi-Diameter of the Axis being as* 266 *to* 265.

Sine 60° = ,08660254 × d by Foc. Dif. ,08663 } Product = ,07502378 Nat. Sine. } 4° 18′ } Comp. 85° 42′ } Half 42° 51′ } Log. Cotang. ,0326241 by Conf. N°. 7015,7 × Foc. Dist. ,08663 = 22,37 Dif. Merid. Parts. } Sph. Merid. Parts } 4527 − 22 = Merid. Parts required 4505

MERIDIONAL PARTS on *Mercator's* CHART, correſponding with the Earth's Convex Surface of a Sphere.

Degrees of LATITUDE.

′	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	′
0	1888	1958	2028	2100	2171	2244	2318	2393	2468	2545	2622	2702	2782	2863	2946	0
2	1891	1960	2031	2102	2174	2247	2320	2395	2471	2547	2625	2704	2784	2866	2949	2
4	1893	1963	2033	2104	2176	2249	2323	2398	2473	2550	2628	2707	2787	2869	2951	4
6	1895	1965	2035	2107	2179	2252	2325	2400	2476	2553	2630	2710	2790	2871	2953	6
8	1898	1967	2038	2109	2181	2254	2328	2403	2478	2555	2633	2712	2792	2874	2956	8
10	1900	1970	2040	2111	2183	2256	2330	2405	2481	2558	2636	2715	2795	2877	2959	10
12	1902	1972	2042	2114	2186	2259	2333	2408	2483	2560	2638	2717	2798	2880	2962	12
14	1904	1974	2045	2116	2188	2261	2335	2410	2486	2563	2641	2720	2801	2882	2965	14
16	1907	1977	2047	2119	2191	2264	2338	2413	2489	2566	2644	2723	2803	2885	2968	16
18	1909	1979	2050	2121	2193	2266	2340	2415	2491	2568	2646	2725	2806	2888	2971	18
20	1911	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	2809	2890	2974	20
22	1914	1984	2054	2126	2198	2271	2345	2420	2496	2573	2651	2731	2811	2893	2976	22
24	1916	1986	2057	2128	2200	2274	2348	2423	2499	2575	2654	2733	2814	2896	2979	24
26	1918	1988	2059	2131	2203	2276	2350	2425	2501	2578	2657	2736	2817	2899	2982	26
28	1921	1991	2061	2133	2205	2278	2353	2428	2504	2581	2659	2739	2820	2902	2985	28
30	1923	1993	2064	2135	2208	2281	2355	2430	2506	2584	2662	2741	2822	2904	2988	30
32	1925	1995	2066	2138	2210	2283	2358	2433	2509	2586	2665	2744	2825	2907	2990	32
34	1928	1998	2069	2140	2213	2286	2360	2435	2512	2589	2667	2747	2828	2910	2993	34
36	1930	2000	2071	2143	2215	2288	2363	2438	2514	2591	2670	2749	2830	2913	2996	36
38	1932	2002	2073	2145	2217	2291	2365	2440	2517	2594	2673	2752	2833	2915	2999	38
40	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	2836	2918	3002	40
42	1937	2007	2078	2150	2222	2296	2370	2445	2522	2599	2678	2758	2839	2921	3005	42
44	1939	2009	2080	2152	2225	2298	2373	2448	2524	2602	2680	2760	2841	2924	3007	44
46	1942	2012	2083	2155	2227	2301	2375	2450	2527	2604	2683	2763	2844	2926	3010	46
48	1944	2014	2085	2157	2230	2303	2378	2453	2529	2607	2686	2766	2847	2929	3013	48
50	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	2849	2932	3016	50
52	1948	2019	2090	2162	2234	2308	2383	2458	2535	2612	2691	2771	2852	2935	3019	52
54	1951	2021	2092	2164	2237	2311	2385	2461	2537	2615	2694	2774	2855	2937	3022	54
56	1953	2024	2095	2167	2239	2313	2388	2463	2540	2617	2696	2776	2858	2940	3024	56
58	1956	2026	2097	2169	2241	2315	2390	2466	2542	2620	2699	2779	2860	2943	3027	58
60	1958	2028	2100	2171	2244	2318	2393	2468	2545	2622	2702	2782	2863	2946	3030	60

MERIDIONAL PARTS on a CHART, correſponding with the Earth's Convex Surface of a Spheroid. Diameters 266 to 265.

Degrees of LATITUDE.

′	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	′
0	1875	1945	2015	2085	2157	2229	2303	2377	2452	2529	2606	2685	2764	2845	2928	0
2	1878	1947	2017	2088	2159	2232	2305	2380	2455	2531	2609	2687	2767	2848	2931	2
4	1880	1949	2019	2090	2162	2234	2308	2382	2457	2534	2611	2690	2770	2851	2933	4
6	1882	1952	2022	2093	2164	2237	2310	2385	2460	2536	2614	2693	2772	2854	2936	6
8	1885	1954	2024	2095	2167	2239	2313	2387	2462	2539	2616	2695	2775	2856	2939	8
10	1887	1956	2026	2097	2169	2242	2315	2390	2465	2541	2619	2698	2778	2859	2942	10
12	1889	1959	2029	2100	2171	2244	2318	2392	2468	2544	2622	2700	2780	2862	2944	12
14	1892	1961	2031	2102	2174	2246	2320	2395	2470	2547	2624	2703	2783	2865	2947	14
16	1894	1963	2033	2104	2176	2249	2322	2397	2473	2549	2627	2706	2786	2867	2950	16
18	1896	1966	2036	2107	2179	2251	2325	2400	2475	2552	2629	2708	2789	2870	2953	18
20	1898	1968	2038	2109	2181	2254	2327	2402	2478	2554	2632	2711	2791	2873	2956	20
22	1901	1970	2041	2112	2183	2256	2330	2405	2480	2557	2635	2714	2794	2875	2958	22
24	1903	1973	2043	2114	2186	2259	2332	2407	2483	2559	2637	2716	2797	2878	2961	24
26	1905	1975	2045	2116	2188	2261	2335	2410	2486	2562	2640	2719	2799	2881	2964	26
28	1908	1977	2048	2119	2191	2264	2337	2412	2488	2564	2643	2722	2802	2884	2967	28
30	1910	1980	2050	2121	2193	2266	2340	2415	2490	2567	2645	2724	2805	2886	2970	30
32	1912	1982	2052	2123	2196	2268	2342	2417	2493	2570	2648	2727	2807	2889	2972	32
34	1915	1984	2055	2126	2198	2271	2345	2420	2495	2572	2650	2730	2810	2892	2975	34
36	1917	1987	2057	2128	2200	2273	2347	2422	2498	2575	2653	2732	2813	2895	2978	36
38	1919	1989	2059	2131	2203	2276	2350	2425	2501	2578	2656	2735	2816	2897	2981	38
40	1922	1991	2062	2133	2205	2278	2352	2427	2503	2580	2658	2738	2818	2900	2984	40
42	1924	1994	2064	2135	2208	2281	2355	2430	2506	2583	2661	2740	2821	2903	2986	42
44	1926	1996	2066	2138	2210	2283	2357	2432	2508	2585	2664	2743	2824	2906	2989	44
46	1928	1998	2069	2140	2212	2286	2360	2435	2511	2588	2666	2746	2826	2908	2992	46
48	1931	2001	2071	2143	2215	2288	2362	2437	2513	2590	2669	2748	2829	2911	2995	48
50	1933	2003	2074	2145	2217	2290	2365	2440	2516	2593	2671	2751	2832	2914	2998	50
52	1935	2005	2076	2147	2220	2293	2367	2442	2518	2596	2674	2754	2835	2917	3000	52
54	1938	2008	2078	2150	2222	2295	2370	2445	2521	2598	2677	2756	2837	2920	3003	54
56	1940	2010	2081	2152	2225	2298	2372	2447	2524	2601	2679	2759	2840	2922	3006	56
58	1942	2012	2083	2155	2227	2300	2375	2450	2526	2603	2682	2762	2842	2925	3009	58
60	1945	2015	2085	2157	2229	2303	2377	2452	2529	2606	2685	2764	2845	2928	3012	60

☞ According to the *Radius of Curvature* = 3994 *Miles*, found for the *Middle* of a Degree of Latitude, meaſured in *Lapland*, Lat. 66° 20′, and *that* of 3958,4 *Miles* found for the *Middle* of a Degree meaſured in *France*, Lat. 49° 22′, the *Ratio* of the Equator's Semi-Diameter to the Earth's Semi-*Axis* is determined (*by the Rules*, p. 295.) as 313,22 to 309,72, or their Squares, as 981.1 to 959.3; when the *Focal* Diſtance from the Center of the Ellipſis = ,149 very nearly. Therefore to *find the Meridional Parts to this Spheroid*, Lat. 60°?

	Product		Comp.	Half	Log. Cotan.	Conſt. N°. *Foc.* Diſt.	Sph. Merid. Parts
Sine 60° = ,8660254	= ,1290378	7° 25′	82° 35′	41° 17′½	,056375	by 9715,7 × ,149	4527
By Foc. Diſt. × ,149	Nat. Sine.					= 66,49 Dif. Merid. Parts.	—66
							Merid. Parts req^d 4461

MERIDIONAL

MERIDIONAL PARTS on *Mercator's* CHART; correfponding with the Earth's Convex Surface of a Sphere.

Degrees of LATITUDE.

′	45°	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	′
0	3030	3116	3203	3292	3382	3475	3569	3665	3764	3865	3968	4074	4183	4294	4409	0
2	3033	3118	3206	3295	3385	3478	3572	3669	3768	3868	3972	4078	4187	4298	4413	2
4	3036	3121	3209	3298	3388	3481	3575	3672	3771	3872	3975	4081	4190	4302	4417	4
6	3038	3124	3212	3301	3391	3484	3578	3675	3774	3875	3979	4085	4194	4306	4421	6
8	3041	3127	3214	3304	3394	3487	3582	3678	3777	3878	3982	4088	4197	4310	4425	8
10	3044	3130	3217	3307	3397	3490	3585	3682	3780	3882	3986	4092	4201	4313	4429	10
12	3047	3133	3220	3310	3400	3493	3588	3685	3784	3885	3989	4096	4205	4317	4433	12
14	3050	3136	3223	3313	3403	3496	3591	3688	3787	3889	3992	4100	4209	4321	4437	14
16	3053	3139	3226	3316	3407	3499	3594	3691	3791	3892	3996	4103	4212	4325	4441	16
18	3055	3142	3229	3319	3410	3503	3597	3695	3794	3895	4000	4106	4216	4329	4444	18
20	3058	3144	3232	3322	3413	3506	3600	3698	3797	3899	4003	4110	4220	4332	4448	20
22	3061	3147	3235	3325	3416	3509	3604	3701	3801	3902	4007	4114	4223	4336	4452	22
24	3064	3150	3238	3328	3419	3512	3607	3705	3804	3906	4010	4117	4227	4340	4456	24
26	3067	3153	3241	3331	3422	3515	3610	3708	3807	3909	4014	4121	4231	4344	4460	26
28	3070	3156	3244	3334	3425	3518	3614	3711	3811	3913	4017	4124	4235	4348	4464	28
30	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	4128	4238	4352	4468	30
32	3075	3162	3250	3340	3431	3525	3620	3718	3817	3920	4024	4132	4242	4355	4472	32
34	3078	3165	3253	3343	3434	3528	3623	3721	3821	3923	4028	4135	4246	4359	4476	34
36	3081	3168	3256	3346	3437	3531	3626	3724	3824	3926	4031	4139	4249	4363	4480	36
38	3084	3171	3259	3349	3440	3534	3630	3728	3827	3930	4035	4143	4253	4367	4484	38
40	3087	3173	3262	3352	3443	3537	3633	3731	3831	3933	4038	4146	4257	4371	4488	40
42	3090	3176	3265	3355	3446	3540	3636	3734	3834	3937	4042	4150	4261	4375	4492	42
44	3093	3179	3268	3358	3449	3543	3639	3737	3838	3940	4046	4154	4264	4378	4496	44
46	3095	3182	3271	3361	3453	3547	3643	3741	3841	3944	4049	4157	4268	4382	4500	46
48	3098	3185	3274	3364	3456	3550	3646	3744	3844	3947	4053	4161	4272	4386	4504	48
50	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	4056	4164	4276	4390	4508	50
52	3104	3191	3280	3370	3462	3556	3652	3751	3851	3954	4060	4168	4279	4394	4512	52
54	3107	3194	3283	3573	3465	3559	3656	3754	3855	3958	4063	4172	4283	4398	4516	54
56	3110	3197	3286	3376	3468	3562	3659	3757	3858	3961	4067	4175	4287	4402	4520	56
58	3113	3200	3289	3379	3471	3566	3662	3761	3861	3965	4070	4179	4291	4405	4523	58
60	3116	3203	3292	3382	3475	3569	3665	3764	3865	3968	4074	4183	4294	4409	4527	60

MERIDIONAL PARTS on a CHART, correfponding with the Earth's Convex Surface of a Spheroid. Diameters 266 to 265.

Degrees of LATITUDE.

′	45°	46°	47°	48°	49°	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	′
0	3012	3097	3184	3272	3363	3455	3549	3645	3743	3844	3947	4052	4161	4272	4387	0
2	3014	3100	3187	3275	3366	3458	3552	3648	3746	3847	3950	4056	4165	4276	4391	2
4	3017	3103	3190	3278	3369	3461	3555	3651	3750	3850	3954	4060	4168	4280	4395	4
8	3020	3106	3193	3281	3372	3464	3558	3655	3753	3854	3957	4063	4172	4284	4399	6
6	3023	3108	3196	3284	3375	3467	3561	3658	3756	3857	3961	4067	4176	4287	4402	8
10	3026	3111	3198	3287	3378	3470	3565	3661	3760	3861	3964	4070	4179	4291	4406	10
12	3029	3114	3201	3290	3381	3473	3568	3664	3763	3864	3968	4074	4183	4295	4410	12
14	3031	3117	3204	3293	3384	3476	3571	3668	3766	3868	3971	4077	4187	4299	4414	14
16	3034	3120	3207	3296	3387	3480	3574	3671	3770	3871	3975	4081	4190	4303	4418	16
18	3037	3123	3210	3299	3390	3483	3577	3674	3773	3874	3978	4085	4194	4306	4422	18
20	3040	3126	3213	3302	3393	3486	3580	3677	3776	3878	3982	4088	4198	4310	4426	20
22	3043	3129	3216	3305	3396	3489	3584	3681	3780	3881	3985	4092	4201	4314	4430	22
24	3046	3131	3219	3308	3399	3492	3587	3684	3783	3885	3989	4095	4205	4318	4434	24
26	3048	3134	3222	3311	3402	3495	3590	3687	3787	3888	3992	4099	4209	4322	4438	26
28	3051	3137	3225	3314	3405	3498	3593	3690	3790	3891	3996	4103	4213	4325	4442	28
30	3054	3140	3228	3317	3408	3501	3596	3694	3793	3895	3999	4106	4216	4329	4445	30
32	3057	3143	3231	3320	3411	3505	3599	3697	3796	3898	4003	4110	4220	4333	4449	32
34	3060	3146	3234	3323	3414	3508	3603	3700	3800	3902	4006	4114	4224	4337	4453	34
36	3063	3149	3237	3326	3418	3511	3606	3703	3803	3905	4010	4117	4227	4341	4457	36
38	3065	3152	3240	3329	3421	3514	3609	3707	3807	3909	4013	4121	4231	4345	4461	38
40	3068	3155	3243	3332	3424	3517	3613	3710	3810	3912	4017	4124	4235	4348	4465	40
42	3071	3158	3246	3335	3427	3520	3616	3713	3813	3916	4020	4128	4239	4352	4469	42
44	3074	3160	3249	3338	3430	3524	3619	3717	3817	3919	4024	4132	4242	4356	4473	44
46	3077	3163	3251	3341	3433	3527	3622	3720	3820	3922	4028	4135	4246	4360	4477	46
48	3080	3166	3254	3344	3436	3530	3625	3722	3823	3926	4031	4139	4250	4364	4481	48
50	3083	3169	3257	3347	3439	3533	3629	3727	3827	3929	4035	4143	4254	4368	4485	50
52	3085	3172	3260	3350	3442	3536	3632	3730	3830	3933	4038	4146	4257	4371	4489	52
54	3088	3175	3263	3353	3445	3539	3635	3733	3834	3936	4042	4150	4261	4375	4493	54
56	3091	3178	3266	3356	3448	3542	3638	3735	3837	3940	4045	4154	4265	4379	4497	56
58	3004	3181	3269	3359	3452	3546	3642	3740	3840	3943	4049	4157	4269	4383	4501	58
60	3097	3184	3272	3363	3455	3549	3645	3743	3844	3947	4052	4161	4272	4387	4505	60

The *Focal* Diftance by Sir *Ifaac Newton's* Theory is ,093, or thereabouts, as Mr. *Emerfon* obferves at *p.* 150 of his *Fluxions*—Hence the *Meridional* Parts by this *New Theory*, from Obfervations made at *Quitto* in *South America*, making the Figure of the Earth nearer to a Sphere than by Sir *Ifaac Newton's* Theory, are greater than thofe by that Theory—*Therefore*, until the *exact* Form and Dimenfions of the Earth be determined, *Tables of Meridional Parts for the Earth's fuppofed Form and Dimenfions, as a Spheroid of fome particular kind, will be a Refinement of no Certainty or Utility in the Practice of Navigation.*

MERIDIONAL PARTS on *Mercator*'s CHART, corresponding with the Earth's Convex Surface of a Sphere.

Degrees of LATITUDE.

′	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	70°	71°	72°	73°	74°	′
0	4527	4649	4775	4905	5040	5179	5324	5474	5631	5795	5966	6146	6335	6534	6746	0
2	4531	4654	4780	4910	5044	5184	5329	5480	5637	5801	5971	6152	6341	6541	6753	2
4	4535	4658	4784	4914	5049	5189	5334	5485	5642	5806	5977	6158	6348	6548	6760	4
6	4539	4662	4788	4919	5053	5193	5339	5490	5647	5812	5983	6164	6354	6555	6768	6
8	4543	4666	4792	4923	5058	5198	5344	5495	5653	5818	5989	6170	6361	6562	6775	8
10	4547	4670	4797	4927	5063	5203	5349	5500	5658	5823	5995	6176	6367	6569	6782	10
12	4551	4674	4801	4932	5067	5208	5354	5505	5664	5829	6001	6182	6374	6576	6790	12
14	4555	4678	4805	4936	5072	5212	5359	5511	5669	5834	6007	6189	6380	6583	6797	14
16	4559	4683	4810	4941	5076	5217	5364	5516	5674	5840	6013	6195	6387	6589	6804	16
18	4564	4687	4814	4945	5081	5222	5368	5521	5680	5846	6019	6201	6393	6596	6812	18
20	4568	4691	4818	4950	5086	5227	5373	5526	5685	5851	6025	6207	6400	6603	6819	20
22	4572	4695	4822	4954	5090	5232	5378	5531	5691	5857	6031	6214	6407	6610	6826	22
24	4576	4699	4827	4959	5095	5236	5383	5537	5696	5863	6037	6220	6413	6617	6834	24
26	4580	4704	4831	4963	5100	5241	5388	5542	5701	5868	6042	6226	6420	6624	6841	26
28	4584	4708	4835	4967	5104	5246	5393	5547	5707	5874	6048	6233	6426	6631	6849	28
30	4588	4712	4840	4972	5109	5251	5398	5552	5712	5880	6054	6239	6433	6638	6856	30
32	4592	4716	4844	4976	5114	5256	5403	5557	5718	5886	6060	6245	6440	6646	6864	32
34	4596	4720	4848	4981	5118	5261	5409	5563	5723	5891	6066	6251	6446	6653	6871	34
36	4600	4724	4853	4985	5123	5265	5414	5568	5729	5897	6072	6258	6453	6660	6879	36
38	4604	4729	4857	4990	5127	5270	5419	5573	5734	5903	6078	6264	6460	6667	6886	38
40	4608	4733	4861	4994	5132	5275	5424	5578	5740	5909	6084	6270	6467	6674	6894	40
42	4613	4737	4866	4999	5137	5280	5429	5584	5745	5914	6691	6277	6473	6681	6902	42
44	4617	4741	4870	5003	5142	5285	5434	5589	5751	5919	6097	6283	6480	6688	6909	44
46	4621	4746	4875	5008	5146	5290	5439	5594	5756	5925	6103	6290	6487	6695	6917	46
48	4625	4750	4879	5012	5151	5295	5444	5599	5762	5931	6109	6296	6493	6702	6924	48
50	4629	4754	4883	5017	5156	5299	5449	5605	5767	5936	6115	6302	6500	6710	6932	50
52	4633	4758	4888	5022	5160	5304	5454	5610	5773	5942	6121	6309	6507	6717	6940	52
54	4637	4763	4892	5026	5165	5309	5459	5615	5778	5948	6127	6315	6514	6724	6947	54
56	4641	4767	4896	5031	5170	5314	5464	5621	5784	5954	6133	6322	6521	6731	6955	56
58	4645	4771	4901	5035	5174	5319	5469	5626	5790	5960	6139	6328	6527	6738	6966	58
60	4649	4775	4905	5040	5179	5324	5474	5631	5795	5966	6146	6335	6534	6746	6970	60

MERIDIONAL PARTS on a CHART, corresponding with the Earth's Convex Surface of a Spheroid. Diameters 266 to 265.

Degrees of LATITUDE.

′	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	70°	71°	72°	73°	74°	′
0	4505	4627	4752	4882	5016	5155	5300	5450	5607	5773	5942	6121	6310	6510	6721	0
2	4509	4631	4756	4886	5021	5160	5305	5455	5612	5776	5947	6127	6317	6516	6728	2
4	4513	4635	4761	4891	5025	5165	5310	5460	5617	5782	5953	6134	6323	6523	6735	4
6	4517	4639	4765	4895	5030	5170	5315	5466	5623	5787	5959	6140	6330	6530	6743	6
8	4521	4643	4769	4899	5034	5174	5320	5471	5628	5793	5965	6146	6336	6537	6750	8
10	4525	4647	4774	4904	5039	5179	5324	5476	5634	5798	5971	6152	6343	6544	6757	10
12	4529	4651	4778	4908	5044	5184	5329	5481	5639	5804	5977	6158	6349	6551	6765	12
14	4533	4656	4782	4913	5048	5189	5334	5486	5644	5810	5983	6164	6356	6558	6772	14
16	4537	4660	4786	4917	5053	5193	5339	5491	5650	5815	5989	6171	6362	6565	6779	16
18	4541	4664	4791	4922	5057	5198	5344	5496	5655	5821	5995	6177	6369	6572	6787	18
20	4545	4668	4795	4926	5062	5203	5349	5502	5661	5827	6000	6183	6375	6579	6794	20
22	4549	4672	4799	4931	5067	5208	5354	5507	5666	5832	6006	6189	6382	6586	6802	22
24	4553	4676	4803	4935	5071	5212	5359	5512	5671	5838	6012	6196	6389	[illegible]	6809	24
26	4557	4680	4808	4939	5076	5217	5364	5517	5677	5844	6018	6202	6395	[illegible]	6816	26
28	4561	4685	4812	4944	5080	5222	5369	5522	5682	5849	6024	6208	6402	[illegible]	6824	28
30	4565	4689	4816	4948	5085	5227	5374	5528	5688	5855	6030	6214	6409	6614	6831	30
32	4569	4693	4821	4953	5090	5232	5379	5533	5693	5861	6036	6221	6415	6621	6839	32
34	4573	4697	4825	4957	5094	5237	5384	5538	5699	5866	6042	6227	6422	6628	6846	34
36	4577	4701	4829	4962	5099	5241	5389	5543	5704	5872	6048	6233	6429	6635	6854	36
38	4582	4706	4834	4966	5104	5246	5394	5549	5710	5878	6054	6240	6436	6642	6861	38
40	4586	4710	4838	4971	5108	5251	5399	5554	5715	5884	6060	6246	6442	6649	6869	40
42	4590	4714	4842	4975	5113	5256	5404	5559	5721	5889	6066	6252	6449	6656	[illegible]	42
44	4594	4718	4847	4980	5118	5261	5409	5564	5726	5895	6072	6259	6455	6663	[illegible]	44
46	4598	4722	4851	4984	5122	5266	5415	5570	5732	5901	6079	6265	6462	6670	6892	46
48	4602	4727	4856	4989	5127	5270	5420	5575	5737	5907	6085	6272	6469	6678	6899	48
50	4606	4731	4860	4993	5132	5275	5425	5580	5743	5912	6091	6278	6476	6685	6907	50
52	4610	4735	4864	4998	5136	5280	5430	5586	5748	5918	6097	6284	6482	6692	6915	52
54	4614	4739	4869	5004	5141	5285	5435	5591	5754	5924	6103	6291	6489	6699	6922	54
56	4618	4744	4873	5007	5146	5290	5440	5596	5759	5930	6109	6297	6496	6706	6930	56
58	4622	4748	4877	5012	5151	5295	5445	5601	5765	5936	6115	6304	6503	6714	6938	58
60	4627	[illegible]	4882	5016	5155	5300	5450	5607	5770	5942	6121	6310	6510	6721	6945	60

If you put l and g = the Logarithm Tangents of the Half Complements of the less and greater Latitude of two Places, (without the *Indices*) c the natural *Tangent* of the ∠ of the Ship's *Course* betwixt the two Latitudes, t the nat. Tangent of 51° 38′ 9″, (whose Logarithm Tangent = 10.1015104) and d the Diff. of Long. in *Miles*. Then $\overline{l-g} \times c = t \times d$. Hence 1. $c = \frac{t \times d}{\overline{l-g}}$; 2. $d = \frac{\overline{l-g} \times c}{t}$; 3. $l = \frac{t \times d}{c} + g$; 4. $g = l - \frac{t \times d}{c}$. ☞ The *Half Complements of Lat. must be reckoned from the same Pole. The 3 last Figures of Log. Tangents of 7, are Decimals.* By these four Rules all Questions in Mercator Sailing, where Longitude is concerned, may be readily answered with Logarithms.

MERIDIONAL

MERIDIONAL PARTS on *Mercator*'s CHART, correfponding with the Earth's Convex Surface of a Sphere.

Degrees of LATITUDE.

′	75°	76°	77°	78°	79°	80°	81°	82°	83°	84°	85°	86°	87°	88°	89°	′
0	6970	7210	7467	7745	8046	8375	8739	9146	9606	10137	10765	11533	12522	13916	16300	0
2	6978	7218	7476	7755	8057	8386	8752	9161	9622	10156	10788	11562	12560	13974	16416	2
4	6986	7227	7484	7764	8068	8398	8765	9175	9639	10175	10811	11591	12589	14033	16537	4
6	6994	7235	7493	7774	8078	8410	8778	9190	9656	10194	10834	11620	12639	14093	16661	6
8	7002	7244	7502	7784	8089	8422	8791	9204	9672	10214	10858	11650	12679	14154	16792	8
10	7010	7252	7511	7794	8099	8433	8804	9219	9689	10234	10881	11680	12719	14216	16926	10
12	7018	7261	7520	7803	8110	8445	8817	9234	9706	10254	10905	11710	12760	14279	17067	12
14	7026	7269	7529	7813	8121	8457	8830	9248	9723	10274	10929	11740	12801	14343	17213	14
16	7034	7278	7538	7823	8131	8469	8843	9263	9740	10294	10953	11770	12842	14408	17366	16
18	7042	7286	7548	7833	8142	8481	8857	9278	9757	10314	10978	11801	12884	14475	17526	18
20	7050	7295	7557	7843	8153	8492	8870	9293	9774	10334	11002	11832	12027	14543	17693	20
22	7058	7304	7566	7853	8164	8504	8883	9308	9792	10354	11027	11863	12970	14612	17870	22
24	7066	7312	7575	7863	8175	8516	8896	9323	9809	10374	11052	11895	13014	14683	18056	24
26	7074	7321	7584	7873	8186	8528	8910	9338	9827	10395	11077	11927	13059	14756	18252	26
28	7082	7329	7594	7883	8196	8540	8923	9353	9844	10416	11102	11960	13104	14830	18461	28
30	7090	7338	7604	7893	8206	8553	8937	9368	9862	10437	11127	11992	13150	14905	18682	30
32	7098	7347	7613	7903	8217	8565	8950	9383	9879	10457	11152	12025	13190	14983	18020	32
34	7106	7355	7622	7913	8229	8577	8964	9399	9897	10478	11178	12059	13243	15062	19174	34
36	7114	7364	7631	7923	8240	8589	8978	9414	9915	10499	11204	12092	13290	15143	19450	36
38	7122	7372	7641	7933	8251	8601	8991	9430	9933	10521	11230	12125	13238	15226	19749	38
40	7130	7381	7650	7943	8262	8614	9005	9446	9951	10542	11257	[illegible]	13386	15311	20076	40
42	7138	7390	7660	7953	8273	8626	9019	9461	9970	10564	11283	[illegible]	13435	15398	20439	42
44	7146	7398	7669	7964	8284	8639	9033	9477	9980	10585	11310	[illegible]	13485	15487	20843	44
46	7154	7407	7678	7974	8295	8651	9047	9493	10006	10607	11337	[illegible]	13536	15579	21303	46
48	7162	7415	7688	7984	8307	8663	9061	9509	10025	10629	11365	12305	13588	[illegible]	21832	48
50	7170	7424	7697	7994	8318	8676	9075	9525	10043	10652	11392	12336	13641	15770	22459	50
52	7178	7433	7707	8005	8329	8689	9089	9541	10061	10674	11420	12372	13694	15870	23226	52
54	7186	7441	7716	8015	8341	8701	9103	9557	10080	10696	11448	12408	13748	15973	24215	54
56	7194	7450	7720	8026	8352	8714	9118	9573	10099	10719	11476	12445	13803	16079	25609	56
58	7202	7458	7736	8036	8364	8727	9132	9590	10118	10742	11504	12483	13859	16188	27992	58
60	7210	7467	7745	8046	8375	8739	9146	9606	10137	10765	11533	12522	13916	16300	Infinite	60

MERIDIONAL PARTS on a CHART, correfponding with the Earth's Convex Surface of a Spheroid. Diameters 266 to 265.

Degrees of LATITUDE.

′	75°	76°	77°	78°	79°	80°	81°	82°	83°	84°	85°	86°	87°	88°	89°	′
0	6945	7185	7442	7719	8020	8350	8713	9120	9580	10111	10739	11507	12496	13891	16274	0
2	6953	7193	7451	7729	8031	8361	8726	9134	9597	10130	10762	11535	12535	13948	16390	2
4	6961	7202	7460	7739	8041	8373	8739	9149	9613	10150	10785	11564	12574	14007	16511	4
6	6969	7210	7469	7748	8053	8384	8752	9163	9630	10169	10808	11594	12613	14067	16636	6
8	6976	7218	7478	7758	8063	8396	8765	9178	9646	10188	10832	11623	12653	14128	16766	8
10	6984	7226	7487	7768	8073	8408	8778	9192	9663	10208	10855	11653	12693	14190	16900	10
12	6992	7235	7496	7777	8084	8419	8791	9207	9680	10228	10879	11683	12733	14253	17041	12
14	7000	7243	7505	7787	8094	8431	8804	9222	9697	10248	10903	11713	12775	14317	17187	14
16	7008	7252	7514	7797	8105	8443	8817	9237	9714	10268	10927	11744	12816	14383	17340	16
18	7016	7260	7523	7807	8116	8455	8830	9252	9731	10288	10952	11775	12859	14449	17500	18
20	7023	7269	7532	7817	8127	8467	8844	9267	9748	10308	10976	11806	12901	14511	17668	20
22	7031	7277	7541	7827	8137	8479	8857	9282	9765	10328	11001	11837	12945	14587	17844	22
24	7039	7286	7550	7837	8148	8491	8870	9297	9783	10349	11026	11869	12988	14658	18030	24
26	7047	7294	7559	7847	8159	8503	8884	9312	9800	10369	11051	11901	13033	14730	18226	26
28	7055	7303	7569	7850	8170	8515	8897	9327	9818	10390	11076	11933	13078	14804	18435	28
30	7063	7311	7578	7867	8181	8527	8811	9342	9835	10411	11101	11967	13123	14880	18657	30
32	7071	7320	7587	7877	8192	8539	8924	9358	9853	10432	11127	11999	13169	[illegible]	18894	32
34	7079	7328	7596	7887	8203	8551	8938	9373	9871	10453	11153	12032	13216	15036	19149	34
36	7087	7337	7606	7897	8214	8563	8951	9389	9889	10474	11179	12066	13264	15117	19424	36
38	7095	7340	7615	7907	8225	8576	8965	9405	9907	10495	11205	12100	13312	15200	19723	38
40	7103	7354	7624	7917	8236	8588	[illegible]	9420	9924	10517	11231	12134	13360	15285	[illegible]	40
42	7111	7363	7634	7927	8248	8600	8993	9435	9943	10538	11258	12168	13410	15372	20413	42
44	7119	7372	7643	7937	8259	8613	9007	9451	9961	10560	11285	12203	13460	15461	20818	44
46	7128	7380	7653	7948	8270	8625	9021	9467	9980	10582	11312	12239	13511	15553	21277	46
48	7136	7389	7662	7958	8281	8638	9035	9483	9998	10604	11339	12274	13563	15647	[illegible]	48
50	7144	7398	7671	7968	8293	8650	9045	9499	10017	10626	11366	12310	13615	[illegible]	[illegible]	50
52	7152	7407	7681	7979	8304	8663	9063	9515	10035	10648	11394	12347	13669	15843	[illegible]	52
54	7160	7415	7691	7989	8315	8675	9077	9531	10054	10671	11422	12383	13723	15946	24189	54
56	7168	7424	7700	7999	8327	8688	9091	9547	10073	10693	11450	12421	13778	16052	25583	56
58	7177	7433	7710	8010	8338	8701	9105	9564	10092	10716	11478	12458	13834	16161	27966	58
60	7185	7442	7719	8020	8350	8713	9120	9580	10111	10739	11507	12496	13891	16274	. . . .	60

LET f = Natural Secant of the Courfe, D = Miles Dift. run, L = Minutes Dif. Lat. Rad. = r; Then $f \times L = r \times D$: Whence,

1. $f=\frac{r \times D}{L}$. 2. $L=\frac{r \times D}{f}$. 3. $D=\frac{f \times L}{r}$; by which RULES, and the former, with *Logarithms*, all Queftions in *practical Navigation* are readily anfwered.

ANOTHER RULE to find the *Meridional Parts for a* CHART *correfponding to the Convexity of a* SPHEROID. Multiply the *Product* of the Sine of the given Lat. (to *Radius* 1) and the *conftant* Number 3437.87, by the *Quotient*, of the Square of the *focal* Diftance from the Center of the *Ellipfis* in Parts of 1, the Semi-conjugate or Earth's Semi-*Axis*, *divided* by that Square more 1, and the *laft Product* will be the meridional Parts lefs than thofe of the *Sphere* for the *Spheroid* of the fame Latitude.

The LENGTH of any DEGREE, and alſo any *Number* of DEGREES, being elliptic *Arcs* of the EARTH's MERIDIAN, in Minutes of the EQUATOR and *Hundredth Parts.* For any Latitude. According to Don *Juan.*

Lat.	Length of a Degree.	Arches of the Meridian.	Lat.	Length of a Degree.	Arches of the Meridian.
°	′ H.	′ H.	°	′ H.	′ Hun.
1	59.55	59.55	46	59.89	2745.17
2	59.55	119.10	47	59.90	2805.07
3	59.55	178.65	48	59.92	2864.99
4	59.56	238.21	49	59.93	2924.92
5	59.55	297.76	50	59.94	2984.86
6	59.55	357.31	51	59.95	3044.81
7	59.56	416.87	52	59.96	3104.77
8	59.57	476.44	53	59.97	3164.74
9	59.56	536.00	54	59.99	3224.73
10	59.57	595.57	55	60.00	3284.73
11	59.57	655.14	56	60.01	3344.74
12	59.58	714.72	57	60.02	3404.76
13	59.58	774.30	58	60.03	3464.79
14	59.59	833.89	59	60.04	3524.83
15	59.59	893.48	60	60.05	3584.88
16	59.60	953.08	61	60.06	3644.94
17	59.61	1012.69	62	60.07	3705.01
18	59.61	1072.30	63	60.08	3765.09
19	59.61	1131.91	64	60.09	3825.18
20	59.63	1191.54	65	60.10	3885.28
21	59.63	1251.17	66	60.11	3945.39
22	59.64	1310.81	67	60.11	4005.50
23	59.65	1370.46	68	60.13	4065.63
24	59.66	1430.12	69	60.13	4125.76
25	59.67	1489.79	70	60.14	4185.90
26	59.67	1549.46	71	60.15	4246.05
27	59.69	1609.15	72	60.16	4306.21
28	59.69	1668 84	73	60.16	4366.37
29	59.70	1728.54	74	60.17	4426.54
30	59.72	1788.26	75	60.18	4486.72
31	59.72	1847.98	76	60.18	4546.90
32	59.74	1907.72	77	60.19	4607.09
33	59.74	1967.46	78	60.19	4967.28
34	59.76	2027.22	79	60.20	4727.48
35	59.77	2086.99	80	60.20	4787.68
36	59.77	2146.76	81	60.21	4847.89
37	59.79	2206.55	82	60.21	4908.10
38	59.80	2266.35	83	60.21	4968.31
39	59.81	2326.16	84	60.22	5028.53
40	59.82	2385.98	85	60.22	5088.75
41	59.84	2445.82	86	60.22	5148.97
42	59.85	2505.67	87	60.22	5209.19
43	59.86	2565.53	88	60.22	5269.41
44	59.87	2625.40	89	60.22	5329.63
45	59.88	2685.28	90	60.22	5389.85

In the above TABLE the *Length* of any Arc, from the EQUATOR, is equal to Length of all the Degrees of Latitude as far as the given *Latitude.*

LENGTH of the *Meridian Arcs* of the SPHERE, by the Reverend Mr. *Murdoch,* confronted with the *Arches* of the SPHEROID, on the Left, by the Dons JUAN and ULLOA.

Lat.	Arches of the Sphere.	Arches Spheroid. Mr. *Murdoch.*	Diff. Sphre and Sphd.	Dif. of Sphd. Arches.	Lat.	Arches of the Sphere.	Arches Spheroid. Mr. *Murdoch.*	Diff. Sphe. and Sphd.	Dif. of Sphd. Arches.
°	′	′	′	′	°	′	′	′	′
1	60	58.7	1.3	0.8	46	2760	2716.4	43.6	28.7
2	120	117.3	2.7	1.8	47	2820	2776.2	43.8	28.8
3	180	176.0	4.0	2.6	48	2880	2835.9	44.1	29.0
4	240	234.7	5.3	3.5	49	2940	2895.5	44.5	29.4
5	300	293.4	6.6	4.3	50	3000	2955.3	44.7	29.5
6	360	252.1	7.9	5.2	51	3060	3015.2	44 8	29.6
7	420	410.8	9.2	6.0	52	3120	3075.0	44.0	29.7
8	480	499.6	10.4	6.8	53	3180	3135.0	45.0	29.7
9	540	528.3	11.7	7.7	54	3240	3194.9	45.1	29.8
10	600	587.0	13.0	8.5	55	3300	3254.9	45.1	29.8
11	660	645.8	14.2	9.3	56	3360	3314.9	45.1	29.8
12	720	704.5	15.5	10.2	57	3420	3375.0	45.0	29.7
13	780	763.3	16.7	11.0	58	3480	3435.1	44.9	29.6
14	840	822.1	17.9	11.7	59	3540	3495.2	44.8	29.6
15	900	880.9	19.1	12.5	60	3600	3555.3	44.7	29.5
16	960	939.7	20.3	13.3	61	3660	3615.5	44.5	29.4
17	1020	998.5	21.5	14.1	62	3720	3775.7	44.3	29.3
18	1080	1057.4	22.6	14.9	63	3780	3736.0	44.0	29.1
19	1140	1116.3	23.7	15.6	64	3840	3796.2	43.8	28.9
20	1200	1175.2	24.8	16.3	65	3900	3856.5	43.5	28.7
21	1260	1234.1	25.9	17.0	66	3960	3916.8	43.2	28.5
22	1320	1293.0	27.0	17.8	67	4020	3977.2	42.8	28.3
23	1380	1352.0	28.0	18.4	68	4080	4037.5	42.5	28.1
24	1440	1411.0	29.0	19.1	69	4140	4097.9	42.1	27.8
25	1500	1470.0	30.0	19.7	70	4200	4158.4	41.6	27.5
26	1560	1529.0	31.0	20.4	71	4260	4218.8	41.2	27.2
27	1620	1588.1	31.9	21.0	72	4320	4279.3	40.7	26.9
28	1680	1647.2	32.8	21.6	73	4380	4339.8	40.2	26.5
29	1740	1706.3	33.7	22.2	74	4440	4400.3	39.7	26.2
30	1800	1765.5	34.5	22.7	75	4500	4460.8	39.2	25.9
31	1860	1824.7	35.3	23.2	76	4560	4521.3	38.7	25.6
32	1920	1883.9	36.1	23.8	77	4620	4581.9	38.1	25.1
33	1980	1943.1	36.9	24.3	78	4680	4642.5	37.5	24.7
34	2040	2002.4	37.6	24.8	79	4740	4703.1	36.9	24.3
35	2100	2061.7	38.3	25.2	80	4800	4763.7	36.3	23.9
36	2160	2121.0	39.0	25.7	81	4860	4824.3	35.7	23.5
37	2220	2180.4	39.6	26.1	82	4920	4884.9	35.1	23.2
38	2280	2239.8	40.2	26.5	83	4980	4945.5	34.5	23.8
39	2340	2299.2	40.8	26.9	84	5040	5006.2	33.8	22.3
40	2400	2358.7	41.3	27.2	85	5100	5066.8	33.2	21.0
41	2460	2418.2	41.8	27.6	86	5160	5127.5	32.5	21.4
42	2520	2477.7	42.3	27.9	87	5220	5188.2	31.8	21.9
43	2580	2537.3	42.7	28.2	88	5280	5148.8	31.2	20.6
44	2640	2596.8	43.2	28.6	89	5340	5309.5	30.5	20.1
45	2700	2656.6	43.4	28.6	90	5400	5370.2	29.8	19.6

By the ABOVE COMPARISON of Mr. *Murdoch's* Arcs of the *Spheroid* with thoſe of the *Sphere,* and alſo with the Arcs of the Spheroid by Don *Juan,* you may *ſee that Juan's* Arcs are about two thirds as much greater than Mr. *Murdoch's* as his are *leſs* than thoſe of the *Sphere;* and conſequently are nearer to thoſe of the Sphere by about 2 Parts of the 3 than the Arcs of Mr. *Murdoch,* by whoſe *meridional* Parts Mr. *Martin's New Sea-Chart* is conſtructed.

IN the above *Table* we have made *Compariſon* of the Difference of Arcs, to give the better *Idea* of their Defects: as of the *Defects* of the meridional Parts by comparing them together.

The beſt Way of ſetting Falſhood *and* Error *in a proper Light being to compare and* confront *them with Truth,* when it can be had.

Of

Of the DIMENSIONS of the EARTH as a SPHEROID.

RULES *for determining the* DIMENSIONS *of the* EARTH *as a Spheroid, or a flatted* SPHERE, *next the* POLES.

PUT $z =$ the Semidiameter of the Earth's *Equator* } The Semi-*transverse*.
$u =$ the Semidiameter of the Earth's *Axis* } The Semi-*conjugate*.
$x =$ the Part of the Semi-diameter of the Earth's Equator from the Center thereof, to where a *Perpendicular* falls on that Semidiameter from the Place of Latitude on the Earth's elliptic Meridian.
$y =$ that Perpendicular, or Semi-ordinate, let fall from the Place of Latitude, on the said Radius of the Equator, or Semi-*Transverse*.
$r =$ the *Radius* of *Curvature*, or of a Circle touching the elliptic Meridian of the Earth in the Place of Latitude.
1, t, s, *Radius, Tangent*, and *Secant* of the Angle of Latitude.

$\frac{u^2}{z^2} = a$. WHENCE, by the Properties of the *Ellipsis* and of *Triangles*, we have the following *Rules*, for determining the *Requisites* of the Earth's Dimensions.

RULE I. $\frac{u^2}{z} = az =$ the *Latus rectum* or *Parameter* of the *elliptic* Meridian.

II. $x = \frac{y}{at} = \frac{z}{\sqrt{1+att}}$; whence $y = atx = \frac{atz}{\sqrt{1+att}}$.

III. $r = \frac{s^3 y}{t + at^3} = \frac{s^3 ax}{1+att} = \frac{s^3 az}{\overline{1+att}|^{\frac{3}{2}}}$.

IV. $z = \frac{r\times\overline{1+att}|^{\frac{3}{2}}}{s^3 a}$, and $z^2 = \frac{r^2\times\overline{1+att}^3}{s^6 a^2} = \frac{\rho^2\times\overline{1+a\tau\tau}^3}{\sigma^6 a^2}$, for ANOTHER LATITUDE. Whence,

V. $a = \frac{r^2\sigma^2 - \rho^2 s^2}{\rho^{\frac{2}{3}} s^2\tau\tau - r^{\frac{2}{3}}\sigma^2 tt} = \frac{u^2}{z^2}$.

CONSTRUCTION of Meridional PARTS continued.

	Product.	*Quotient.* $\frac{\text{fo. Dist.}}{\text{fo. Dif.} + 1}$	*Last Product.*		
THUS, Sine Lat. 60° = ,8660254 } ×d by Const. N°. 3437,87 }	2997,282742	by ,00750466	22.49	4527 Mer. Parts Sphere. −22 ——— 4505 Mer. Parts Sph^d^.	Lat. 60°.

RULE for *nearly determining the same.* Multiply a *few* Figures of the *natural Sine* of the Latitude *(to Radius* 1) by 3 and the Product of that 3, and the first Figure, with what is carried, will be the *Difference* that the meridional Parts of the *Spheroid* are *less* than those of the *Sphere*, for the same Latitude, when the Difference of the Diameters of the Spheroid is *small*: otherwise this *Rule* is of no Use.

Example. Sine Lat. 60° = ,866, *&c.* by 3 (as directed) = 25.98 Diff. Merid. Parts *less*, nearly as above: Agreeing with Don *Juan*'s Tables for Semi-Diameters of the Spheroid as 266 to 265, compared with the meridional Parts of the Sphere, foregoing. *See P.* 292.

By M. *Maupertuis* the *Ratio* of the Earth's Diameters is as 313,22 to 309,72; from whence the *two* correct *general Rules* (before given) find the Difference of meridional Parts 66,49 for the same Latitude, *viz.* 60°.

By the other *Ratio* of the Diameters 266 to 265, we have only 22 for Difference.

Don *John George Juan* and Don *Antoine de Ulloa*, measured a *Degree* of the Meridian near the Equator in *South America*, in the Kingdom of *Quito*, as their Book sets forth, (first published in *Spanish*, and then translated into *French)* who first undertook the Work in the Year 1736, and afterwards found 56767,788 *Toises* in a Degree: which is greater than the *spheroidal Theory* gives it, by about 268 *Toises*, from a Computation depending on the Measure of a Deg. of the Merid. in *Lapland*, and another in *France*. From which last *Mensuration* in *America*, Don *Juan* determined the *Ratio* of the *spheroidal* Diameters of the Earth to be (as before observed) 266 to 265; a *Ratio* much *nearer* than that determined by Sir *Isaac Newton* (from the Theory of Gravity and Earth's Density) than was before determined from the Measure of a Degree in *Lapland* and another in *France*.

The *meridional* Parts for Latitude 89° to the *Spheroid* by Don *Juan* = 16273,7, Nat. Sine 89° is ,9998 and ×d by 3 (as directed) = 29,99, *&c.* = 30 the greatest Diff. the meridional Parts of the *Spheroid* are less than those for the *Sphere*. Whence from 16300 meridional Parts for Sphere, deduct 30, and there remains the meridional Parts for the same Latitude, *viz.* 16970.

Mr. *Murdoch*'s meridional *Parts* (by which Mr. *Martin*'s *New Chart* is constructed) and Don *Juan*'s for the Spheroid, differ from the meridional Parts of the *Sphere*, for the same Latitude of 60°, by 66 and 22; and these from one another by 44, therefore the *new Chart* and Don *Juan's Tables* (published for equal Advantage to Navigation) differ twice as much from one another as *Juan*'s Tables differ from the Sphere. That if *Juan*'s Tables are near the Truth for the *Spheroid*, (making the Figure of the Earth almost as near to a *Sphere* as Sir *Isaac Newton* made it) then *Martin*'s *new Chart* (from *Murdoch*'s or *Maupertuis*'s Principles) is doubly erroneous, (in the *Instance* before us, of the Proportion of merid. Parts for Lat. 60°) differing *twice* as much under *Juan*, as *Juan* differs under the Sphere, or Chart of *Mercator*.

OBSERVATION

From

Of the DIMENSIONS of the EARTH as a SPHEROID.

From above $z^{\frac{2}{3}} = \dfrac{r^{\frac{2}{3}} + r^{\frac{2}{3}}att}{s^2 a^{\frac{2}{3}}} = \dfrac{r^{\frac{2}{3}} + r^{\frac{2}{3}}att}{a^{\frac{2}{3}} + a^{\frac{2}{3}}tt}$, by *Substitution* of $t^2 + 1$ for s^2; becauſe $s^2 - t^2 = 1$.

Whence,

$$\text{VI.}\quad tt = \frac{r^{\frac{2}{3}} - a^{\frac{2}{3}} z^{\frac{2}{3}}}{a^{\frac{2}{3}} z^{\frac{2}{3}} - a r^{\frac{2}{3}}} = \frac{1 - a^{\frac{2}{3}}}{a^{\frac{2}{3}} - a}, \text{ when } r = z.$$

N. B. At the *Equator* (when $s = 1$, and $t = 0$) $r = az$.
At the *Pole* (when s and t are *infinite* and *equal*, and a finite being added to an infinite Quantity makes no Difference)

$$r \left(= \frac{s^3 az}{\overline{1 + att}|^{\frac{3}{2}}} = \frac{t^3 az}{\overline{att}|^{\frac{3}{2}}} = \frac{az}{a^{\frac{3}{2}}}\right) = \frac{z}{a^{\frac{1}{2}}}.$$

⁂ *The above* RULES (of genuine EXTRACTION) *are correct and uſeful when the Radius of Curvature* r *can be* firſt *very nearly, or exactly, found. But Mr.* MARTIN *has applied them to no Purpoſe, Truth, or Advantage, by finding an incorrect Radius of Curvature as follows.*

PROPOSITION I. *To find the* Radius *of Curvature of the Earth in Miles, correſpondent to the Middle of a Degree meaſured on the elliptic Meridian of the Earth's Surface.*

Example. In Latitude 66° 20′, a Degree of the Earth's Meridian has been meaſured and found to be 57437,9 *French Toiſes*, whence the *Radius of Curvature r*, will be firſt found in Degrees, for the Middle of that Degree, by this PROPORTION, according to Mr. *Martin*. As 3,141593, *&c.* : 1 :: 360 : $2r$ :: 180 : r =

	Logarithms.
180°	2.2552725
3,141593	0.4971499
r = 57°,29578	1.7581226
Toiſes in 1° are 57437,9	4.7591985
Log. of *Toiſes* in r	6.5173211
Toiſes in an *Engliſh* Mile 823,97	2.9159114
Engliſh Miles in r = 3994,115	3.6014097

⁂ In the ſame *Manner*, from the Length of a Degree of the Earth's Meridian, near *Paris*, being meaſured, and found to be 56925,7 *Toiſes*, the Length of the *Radius* of Curvature of the Earth will be found 3958.4 *Engliſh Miles*, for the Middle of that Degree. A Degree by Don *Juan* = 56767,79 Toiſes, at the Equator gives Radius of Curvature 3947,42 *Engliſh* Miles. *But this Curvature is according to the ſuppoſed* ſpherical *and not* ſpheroidal *Form of the Earth, and therefore* incorrect.

OBSERVATION on the latter *Part* of the INTRODUCTION to the *New Principles* of *Geography* and *Navigation*, by *B. Martin*; *pointing* at Mr. EMERSON, and miſrepreſenting his Judgment and the TRUTH.

SAILING by the *Spheroid* inſtead of by the *Sphere*, (till the *larger Errors of the Courſe and Diſtance* can be truly corrected) is *ſimilar* to correcting the *ſmall* Equations of the Moon's Orbit, while the *larger Ones*, or even thoſe of the mean Motions, are left *largely defective*.

To what Purpoſe then are the different Principles of *Murdoch* and *Juan* introduced to the *Practice* of Navigation, and called *New Principles of Geography* and *Navigation*, when neither (of thoſe widely different Principles) are *certain*?

And for the *Author* of theſe *Principles* to ſuppoſe Mr. EMERSON *depreciated* what *he did not*, (who gave his Reaſon for what he ſaid, and was unanſwered) is the ſame as if Mr. *Emerſon* were to ſuppoſe his *Depreciator* to be what *he is not*, and ſo preſs and degrade him with the *Conſequences* of the *erroneous Suppoſition*.

RE-REVIEWER.

To the AUTHOR of the ROYAL ASTRONOMER and NAVIGATOR.

REMARKS on a BOOK intitled *New Principles of Geography and Navigation*, *pretending* to more *Exactneſs* than TRUTH and PRACTICABILITY.

AS to theſe *New Principles* of *Navigation* they are taken all from *Murdoch*. When I read them I found the Reaſoning not *Sterling*. The Table of *meridional* Parts, the very *Examples* and the *Remarks* are all *Murdoch's*, making up the *firſt* Part of this *new Navigation*.

Murdoch's Book is a *Quarto* Pamphlet of 38 Pages, beſides an Introduction of 32 Pages, printed in 1741, intitled *Mercator's Sailing applied to the true Figure of the Earth*; a Book exceeding the *New Principles of Navigation*; but the wiſer Author (I have heard) has propoſed to retract his *Errors*.

The *principal* Things of Note in the *new Principles* of Navigation are theſe.

In *Page* 12. the Author is pleaſed to tell us, from *Maupertuis* and *Picard*, that the Earth's *Semi-axis* to the *Radius* of the Equator is as 309,72 to 313,22; from whence it follows, that the *Exceſs* of the Height at Equator is $\frac{1}{90}$ of the *Radius*. Sir *Iſaac Newton* made it [illegible] only, by Computation.

Page 19. The Author of the *New Principles* calls the *Diſtance* of the Place (a Ship arrives at) from the Meridian of the Place failed from, by the Name of *Departure*; though Departure and meridional Diſtance are of a *different* Nature: Which ſhews that this Author knows Nothing of what Departure is; and therefore a very fit Perſon to write a Book of Navigation!

Page

PROPOSITION

Of the DIMENSIONS of the EARTH as a SPHEROID.

PROPOSITION II. *To determine the* Ratio *of the Semidiameter of the* EARTH's EQUATOR, *to the Semidiameter of the* EARTH's AXIS, *from the* Radius *of Curvature, and Latitude, for two Places, on the Earth's Surface being given?*

To perform which, the Value of a must be first determined by RULE V. foregoing.

Latitude.		Com. Logarithms.		
			By *Lapland* and *France.*	
Lapland 66° 20′	$r=3994{,}115$ Miles $t=2{,}2816693$ $s=2{,}4911874$	3.6014097 0.3582527 0.3964064	$a=\dfrac{r^{\frac{2}{3}}\sigma^2-\rho^{\frac{2}{3}}s^2}{\rho^{\frac{2}{3}}\tau\tau ss-r^{\frac{2}{3}}tt\sigma^2}=\dfrac{959.352}{981.345}=\dfrac{u^2}{z^2}$	$r^{\frac{2}{3}}\sigma^2=593.604$ $\rho^{\frac{2}{3}}s^2=1552.956$ $\rho^{\frac{2}{3}}\tau\tau ss=2108.967$ $r^{\frac{2}{3}}tt\sigma^2=3090.312$
			By *Lapland* and *Equator.*	
France 49° 22′	$\rho=3958{,}4$ Miles. $\tau=1{,}1653472$ $\sigma=1{,}5355892$	3.5975195 0.0664554 0.1862750	$a=\dfrac{1298.347}{1310.543}=\dfrac{u^2}{z^2}$	$r^{\frac{2}{3}}\sigma^2=251.737$ $\rho^{\frac{2}{3}}s^2=1550.084$ $\rho^{\frac{2}{3}}\tau\tau ss=0.$ $r^{\frac{2}{3}}tt\sigma^2=1310.543$
			By *France* and *Equator.*	
Equator 0°	$\rho=3947{,}42$ Miles. $\tau=0.$ $\sigma=1.$	3.5963132 0.0000000	$a=\dfrac{338.7345}{339.8269}=\dfrac{u^2}{z^2}$	$r^{\frac{2}{3}}\sigma^2=250.234$ $\rho^{\frac{2}{3}}s^2=588.9685$ $\rho^{\frac{2}{3}}\tau\tau ss=0.$ $r^{\frac{2}{3}}tt\sigma^2=339.8269$

Here putting *Lapland* Letters for those of *France.*

Page 23. This Author of the *same Principles,* projects the Arch of the Meridian upon the *Tangent,* by an Eye at the Earth's Center, perhaps with Design to find the *meridional Parts.* If this was his Meaning, then the meridian Line for any Latitude is no more than the *Tangent* of that Latitude: because any *Arch is projected into its Tangent by an Eye at the Center.*

This Author likewise represents sailing by *middle Latitude* as not deserving his Notice or Regard; though every *Seaman* knows, in short Distances, as far as any Ship can run in 24 Hours, that the *Difference* by this *Method* from that of *Mercator,* in keeping a Ship's Reckoning of Longitude and Latitude, is not sensible; which Method of *Middle-Latitude-Sailing* is therefore a very useful *Approximation.*

Page 32. He speaks of a *Compass,* which is to be more than 100 Times stronger than those of the common Sort, by which, I suppose, that he intends to sail 100 Times more correctly than by the *common Methods in Practice.*

Page 35. He does not reckon *Departure* any Element of Navigation, or as belonging to the *Art of Sailing,* because it cannot be known from Observation; nor is it thought (by this Author) of any real Use, being determined by *Computation*; but leads (as he thinks) to Error. But does not every Body of Experience in Navigation know, that all the *Eastings* and *Westings* are so many *Departures*; and that the *Sum* of them lying *one Way,* or Difference the other, is the total Departure, made in 24 Hours-Run; and extremely near the Truth.

In Page 36. He makes use of Departure in Calculations, though he had said before it was *useless*; who has here forgot himself. He resolves all his Cases *mechanically,* by Scale and Compass, and instead of a Scale uses *Paper-Schemes,* from which no Certainty can be expected; which, however, I submit to the *Trial* of others.

Page 43. He says the Way of Working on his *Chart* is the same as on any other; he only proposes to be more exact.—Why then (in the Name of Wisdom) does he call them *New Principles?*

He gives us a *Table* of the Magnitude of the Earth's Parallels, as *Murdoch* has done; nor seems to suppose them *any Way* different from those of the Sphere, for any Thing he has shewn to the contrary in his Book of *New Principles.* If so, he might as well suppose all the Degrees of the Meridian to be equal.

There is no such Thing in this *whole Book* as any Correction of *Latitude* or *Longitude*; as if they were but *Trifles* not worthy his Regard: while every *experienced Navigator* is sensible, that there is no *Sailing* without such Correction. But the Use of his *new Compass* and *Dromometer* may make that Correction needless, as ~~a Means~~ for the *Defect.* amends is made

In the *second Part* of this new Performance, the Author has given another Table of Meridional Parts from Don *Juan*'s Book, quite *different* from the former he took from *Murdoch.*

Don *Juan* makes the *Radius* of the Equator to the Earth's *Axis,* as 266 to 265, and therefore the *Excess* of the Height of the *Equator* is $\frac{1}{266}$ Part of the Radius; which is not half so much as the other from *Maupertuis* and *Murdoch,* and is not far different from the *Ratio* by Sir *Isaac Newton.*

But, from his finding the great Difference, *he softens a little,* and says, *that either the Earth is not a perfect Spheroid, or there are some Errors committed in the Mensuration:* And is forced to say, *that it is difficult to determine the true Ratio.* What then shall we trust to? And what is come of this *Bray* of representing the Spheroidal Surface of the Earth and Sea, *without any Error at all,* (See Page 27).

This is to be remarked, that since his *first* Way from *Maupertuis* and *Murdoch* makes the Earth differ *twice* as much from a *Sphere,* as his *second* Way from *Juan* and *Newton.* That if *Juan* and *Newton* are right, *(and who can shew the contrary)* then it *will* follow that the *Sphere*

Of the DIMENSIONS of the EARTH as a SPHEROID.

By the three *Ratios* found of the Squares of the Earth's Diameters,

$$\frac{u^2}{z^2}=a=\frac{959.352}{981.345}=\frac{,977589}{1}=,977589;\ \frac{u}{z}=\frac{,988731}{1}$$

$$a=\frac{1298.347}{1310.543}=\frac{,9906937}{1}=,9906937;\ \frac{u}{z}=\frac{,995336}{1}$$

$$a=\frac{338.7345}{339.8269}=\frac{,9967855}{1}=,9967855;\ \frac{u}{z}=\frac{,9983917}{1}$$

Here you may see how this same Method, by Mr. *Martin*'s mistaken Radius of the Earth's Curvature, gives the Ratios of the Earth's Diameters, very different.

The *Ratio* of the Earth's Diameters according to Don JUAN, $\frac{u}{z}=\frac{265}{266}=\frac{,996240}{1}$.

☞ HENCE *is shewn the* ERROR, *of Mr.* MARTIN's METHOD *of determining the Ratio of the Earth's Diameters, by an incorrect Radius of Curvature.*

OTHERWISE: According to M. MAUPERTUIS' METHOD of determining the said RATIO; Mr. *Martin* not chusing to depend on his RULES given, at P. 10. 11. in his *New Principles* of NAVIGATION; who has therefore followed THIS METHOD.

LET the *Radius* of the Equator to the *Semi-axis* be as 1 to n; and A and B the Length of *two different Degrees*, measured in different Latitudes; and a and b the respective *Sines* of those Latitudes; then, from the *Properties* of an *Ellipsis*;

$$A\times\overline{1+\tfrac{3}{2}\times\overline{n^2-1}\times a^2}=B\times\overline{1+\tfrac{3}{2}\times\overline{n^2-1}\times b^2},$$

$$\text{Or, } 1-n^2=\frac{2\times\overline{A-B}}{3\times\overline{Aa^2-Bb^2}},\ \text{ where } n=\sqrt{1-\frac{2\times\overline{A-B}}{3\times\overline{Aa^2-Bb^2}}}.$$

Sphere is as near the true Figure of the Earth as his *first Figure*, drawn from *Maupertuis*. And therefore those that use the *meridional* Parts for the *Sphere* will come as nigh the Truth as those who follow his first Method from *Murdoch* and *Maupertuis*.

What then can be said of this *Boasting Refiner*? Can this *Refined Navigation* give the true Figure of the Earth so as to found any certain Computations upon it. If not, all that he has said *imports Nothing to the Purpose*. And who would not sooner follow the *simple* Method by the *Sphere*, than follow an *uncertain Method*, only for the Sake of its Novelty and Difficulty, when the Difference is *insensible and useless*?

When he comes to compare the different Measures of a Degree on the Earth's Surface, this *Author* is in the utmost *Distress*, and tries to accommodate them, by taking a *Mean*; *but what Right has he to do that?* Or, *who will trust to the Truth merely upon his Word*, when Sir *Isaac Newton*'s would not be taken without *Demonstration*?

I wonder how he got it into his Conception, that Mr. *Emerson* depreciated that Discovery of the Spheroidal Figure of the Earth which is truly a very noble one in natural Philosophy. He only called it an *idle Refinement* when applied by *Pedants* to the *Practice of Navigation*, where it can make no sensible Difference; and must create an endless Deal of Trouble for no useful Purpose. Mr. *Emerson* gave his Reasons for calling it an *idle Refinement*, towards the latter End of his Preface, without Design (he says) of offending any Body. And what Right has any Man to *depreciate* another's Judgment, for what he advances, unless he properly answers him; which the Author of the *New Principles* (long since discovered) never once attempted.

And Mr. *Emerson* still continues to affirm, that the *trifling Difference* it makes is not worth the immense Labour (*of making meridional Parts and new Arches*) that it causes. That as we know nothing what *Species* of a Sphere is the Earth is, or whether it is a Spheroid at all, or not? I hope you will not follow this refined Author's Steps of inserting a *Table* of meridional Parts for the Spheroid, except it be to *confront and compare* with those of the Sphere, and confute the *pretended Advantage of Spheroidal above Spherical Navigation* by Examples given of both, to shew the useless *Difference*.

The Reason why *Simpson*'s Difference of the Meridional Parts is *less* than the Spheroidal Author's, is because *Simpson* uses Sir *Isaac Newton*'s Numbers 229 to 230. I have found that the Difference $=343895$, where $s=$ *Nat. Sine Lat.* $q=1-aa$, $a=$ *Semi-Axis of the Earth.*

As to *Robertson*'s Navigation you mention, it is rather a *Course of Mathematics*; for it contains almost all Branches of practical Mathematics. *Barrow* is much the same, and follows *Murdoch* in the Spheroid.

In the *Voyages* you have made you observe, that neither *Course nor Distance can be truly ascertained.* And therefore who would go about to take an immense Deal of Trouble to avoid an *Error* which is involved with *another*, ten or twenty Times as great; and which is unavoidable; and yet *these Errors, as well one as another, may be all corrected from taking an Observation.*

I know no Way of correcting the *Departure* but by finding the Longitude to every particular *Course*; yet this is troublesome, and in 24 Hours is *insensible*; and therefore in Practice every Body makes use of the whole *Easting* or *Westing*, instead of it.

YOUR METHOD of finding the *Departure*, Difference of *Longitude, Latitude*, &c. by the *Seaman*'s COMPUTER, &c. is *pretty enough*, and will be of Use in *Practical Navigation.*

I know of nobody that has taken the Trouble to compute the Meridional Parts to the Spheroid, but *Murdoch* (which is only in *whole Degrees*) and what the Author of the *New Principles* gives us from *Juan*.

As to the *Tables* of reputed *Longitude* and *Latitude* of Places, there is a great Difference among Authors.

The *best Method* to ascertain them *nearest* (since exact Truth cannot be had) is by *comparing* several Books together, and where they differ, to apply to the *best Maps*.

The *Longitudes* are best reckoned from the westermost Part of *Africa*, as being long since established by Custom, and ought not to be altered. Thus, the *cœlestial Longitudes* are reckoned from the *first Point of Aries*, and ought not to be altered; though some *whimsical* Persons, in Contradiction to a settled Custom, might reckon them from *Libra*, or any other Point of the Ecliptic. NEWTONIENSIS.

Or

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Or, (more simply) putting $m = 1 - n$, then $n = 1 - m$, and $n^2 = 1 - 2m + m^2$, where m^2 being very small, in Respect of the other Terms, may be *rejected*; and $n^2 = 1 - 2m$, and $1 - n^2 = 2m = \frac{2 \times A - B}{3 \times Aa^2 - Bb^2}$ above.

Whence, $m = \frac{A - B}{3 \times Aa^2 - Bb^2}$; or when B nearly A,

Then, $m = \frac{A - B}{3A \times \overline{a^2 - b^2}}$, as is evident.

Now, if the *Measure* of *one of the Degrees* be taken near the *Equator* (*when* $b = 0$) then $m = \frac{A - B}{3Aa^2}$, as is also evident.

Whence, we have $B = A - 3Aa^2m$, the *Length* of a Degree of the Meridian at the *Equator*.

EXAMPLE. LET $A = 57437,9$ *the* Toises *in a Degree in* Lapland, *and* $B = 57050$ *the* Toises *in a Degree at the Parallel of* 45° *in* France.

Then, by the Equation foregoing, $m = 0,006646 = 1 - n$,
Whence, $1 - 0,00646 = 0,99354 = n$.
Therefore, $1 : n = ,99354 :: 266 : 264,3$ the *Ratio* of the Earth's Diameters.

CONSEQUENTLY, *To find the Length of a Degree at the Equator?*

LET $A = 57437,9$ *Toises* in a Degree measured in *Lapland*, and we have by the Equation $B = A - 3Ama^2 = 56501\frac{3}{4}$ *Toises* at the *Equator*: Or, if A be taken $= 57050$ *Toises* in a Degree of Latitude in *France*, under the *Parallel* of 45°, Then $B = A - 3Ama^2 = 56497,2$ the *Toises* in a Degree at the Equator.

From both which *Methods*, of M. *Maupertuis*, by a Degree measured in *Lapland*, and another measured in *France*, a Degree at the *Equator* should be *nearly* 56500 *Toises*; being *less* than the Degree measured there by Don *Juan*, at the *Equator*, by about 268 *Toises*.

BUT, admitting the Truth of Don *Juan*'s Measure of a Degree at the Equator, and also of the Measure of a Degree before in *France*, Latitude 45°, Then $m = 0,003297$; Whence $1 : n = ,9967 :: 266 : 265,12$; according to which *Ratio*, *viz.* 266 to 265, Don *Juan* has *fixed* the *Ratio* of the Earth's equatorial to the polar Diameter; as on which *Hypothesis* he has computed *his Table* of *meridional Parts* of the Earth, as a *Spheroid*, which meridional Parts we have given with those of the Sphere for the *Navigator*'s *Trial* and *Curiosity*.

If the two *extreme Degrees*, measured in *Lapland* and at the *Equator*, be taken as true, Then $A = 57437,9$ and $B = 56767,788$, whence $m = \frac{A - B}{3Aa^2} = 0,004625$.

Consequently, $1 : n = 0,99537 :: 266 : 264,73$, being a *mean* Quantity between 264,3 and 265,12 the Numbers before found, as Members of the *Ratio*, from the Measure of a Degree in *Lapland* and *France*, and *France* and at the *Equator*.

	By M. *Maupertuis'* Method.	According to the *New Principles of Navigat.* By Mr. *Martin*.	*From a Degree measured in*
NOW,	1 to ,99354	1 to ,98873	*Lapland* and *France*,
	1 to ,9967	1 to ,99839	*France* and at the *Equator*,
	1 to ,99537	1 to ,99533	*Lapland* and *Equator*.

WHENCE, it evidently appears, if M. *Maupertuis*' Method of determining the *Ratio* of the Earth's Diameters, by two different and distant Degrees measured on the Earth's Surface, be *nearly* true, as it appears to be *consistent* in the *near* Agreement of the *different* Answers, it also appears as evident, that the *Method*, by the *New Principles of Geography and Navigation*, for determining the *Ratio* of the same Earth's Diameters, is erroneous; from the different Answers to the same *Requisites*, deduced as above. For it supposes (*what is not*) an *elliptic Arc to be circular*, *for a Degree*; *and the Middle thereof*, *of circular Curvature*, to *coincide* with the *elliptic Curvature of the Earth's Meridian*. *The Radius of Curvature likewise of the measured Degree considered as a circular Arc, to be the Radius of Curvature to the Middle of that Degree of the elliptic Meridian. Which to suppose, is against the Hypothesis admitted, and Dimensions of the Earth sought, as a Spheroid, formed by the Rotation of the Semi-ellipsis about its shorter or polar Diameter*; not "*about its longer Diameter*," as is asserted in the *Introduction to the New Principles of Navigation*.

☞ HENCE, it necessarily follows, that the Solutions to the XI *Problems*, P. 12, 13, 14, of this *New Navigation*, are from erroneous Principles, differing from the *Truth*, by *other Methods*; as in the *Scholium*, P. 14, is signified.

Of the DIMENSIONS of the EARTH as a SPHEROID.

The MEASURE *of the* EARTH *at* different Times *by different* PERSONS.

Years since Christ. PERSONS NAMES *measuring* PLACES NAMES *measured.* *Geographical Miles.*

800 . . . . *Almamoon*, Caliph of *Babylon* : . . *Babylon* . . . . 56, or 57.

1525 . . . . *Fernelius* . . . . *France* . . . . 68.

Snellius, a *Dutch* Mathematician . between *Alcmaer* and *Bergen-op-Zoom*, to 1° 11′ 30″ . . *Alcmaer* and *Leyden*, a *Mean* of both . . . . } *French Toises.* 55021 in a Degree.

Miles.

1635 . . . . *Norwood*, an *Englishman* : . . between *London* and *York* . . . . $69\frac{1}{2}$ in a Degree. = 367196 Feet.

1654 . . . . *Ricciolus*, by *several Methods* found the Earth's Circumference . . 64363 *Bologna Paces.* or 61650 Toises.

LEWIS XIV. . . . *M. Picard* measured between *Malvoisine* and *Amiens* *Toises.*
Less than *Norwood* in a Deg. by 240 *Toises* . . 788500 *Toises* to 1° 22′ 55″ . . 57060 to 1°.

1718 . . . . *M. Cassini* measured the whole Meridian of *France.* *Toises.*

From *Paris* to *Collioure* 57097
Paris to *Dunkirk* . . . . 56960 } to 1°.
Same as *Picard* . . *Dunkirk* to *Collioure* 57060

Mr. *Muschenbrook*, correcting *Snellius*, measured the same Arch, and found . . . 57033 to 1°.

*** *The above* Measurements *had been sufficient for determining the Earth's Dimensions as a Sphere, but Disputes arising about its Figure, according to Sir* Isaac Newton, *as a* Spheroid, *further Measure was made, to determine this important Truth, as near as possible.*

Began 1736 . . . Messieurs *Clairaut, Camus, Le Monnier, Maupertuis*, the Abbe *Onthier*, of *France*, M. *Celsus*, Professor of Astronomy at *Upsal* . . . . } measured a Degree in *Lapland*, near the Arctic Circle . . . } *Toises.* 57437,9 to 1°.
ended Dec. following.

Picard's less by . . . 377,9

Picard's corrected, allowing for *Aberration* of Light, of the observed *Star*, the Precession of *Æquinoxes*, Refraction of Light, (*before neglected*) . } 56925,7 to 1°.

Less than at the *Polar Circle* : . 512,2

☞ *Doubts* arising about the Difference of a Degree in *France*, at the Return of the *Academicians* from the North, the Arch was remeasured by *Cassini de Thury* (Grandson to the former) and *De la Caille*, the Work was intitled, *La Merid. de Paris verifiée*, 45° Parallel. . . . . *Toises* 57050 to 1°.

The Difference of a Degree in *Lapland* and *France* proved the Figure of the Earth to be *no Sphere*, but rather a *Spheroid*; the *Ratio* of which Diameters (the *less* Polar to the *greater* equatorial) were now to be correctly determined. On which *Ratio* were now to depend the Improvement of *Geography* and *Astronomy*, and also *Navigation*, so far as the *Earth's Figure* can be applied to the *Practice of that Art*. To which End a further Measure was applied near the Earth's *Equator*.

Set out 1735 . . Don *George Juan*, Don *Antoine de Ulloa*, attending the *Academicians* from *France*, by whom *two Observatories* were erected in the Plain of *Yaruqui*, one at *Pueblo Viejo*, and the other at *Cuenca*, by which, with a great Number of Signals erected, they formed and measured about 30 Triangles, and obtained a *Base Line* of 195734,574 *Toises*, between the Parallels of *Pueblo Viejo* and *Cuenca* . . . . } *Pueblo Viejo* to *Cuenca*. Lat. 0° 32′ 45″ N. 2° 54′ $7\frac{3}{4}$″ S.
See Juan's *Book.*

32 45

Diff. Latitude . . . . Sum 3° 26′ $52\frac{3}{4}$″.

As 3° 26′ $52\frac{3}{4}$″ : 195734,547 *Toises* :: 1° at the *Equator* : 56767,788 *Toises*.

☞ Taking *Toises* 57437,9 / 57050, } in a Degree { at the *Arctic Circle*, / under Parallel of 45° N. or *France* } by *Rules* before given { *Ratio* of

The Earth's *Semi-Axis* to the Semidiameter of the *Equator*, as 264,3 to 266.

Nearer to Sir *Isaac Newton* . . . Don *Juan* determines it to be 265 to 266.

It is known, that $1^3 : n^3$ (1 to *n*, being the *Ratio* of the *Equatorial* to the *Polar* Diameter) :: *Length of a Degree at the Equator* : to the *Length of a Degree at the Pole, by the* elliptic Theory. Or, 1 : *n* :: 266 : 265. *Therefore*, $265|^3 : 266|^3$ :: 56768 *Toises* in a Degree, at the *Equator* : 57438 *Toises* in a Degree at the *Pole*. *But*, they are the *Toises* in a Degree at *Lapland* near the *Arctic Circle*, and much less than in a *Degree at the Pole*. *Hence*, the Number 265 is a little *too large* (as it is said by the *Refiner*) in the *Ratio* of 266 : 265, the *Equatorial* to the *Polar* Diameters of the Earth. And therefore the *Matter* is still in *Dispute* as to the true Figure of the Earth, whether it is an *exact Spheroid*, or not; and the *Doubt* is likely to remain, till we can measure the Length of a *Degree* at the *Pole* (*non est habitabilis Nive*). That, upon the *whole* (*notwithstanding the late Author's pretended Improvements by the elliptic Chart*, constructed from *Meridional* Parts on *wrong* Principles) the *Mercator's Chart*,

for

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for *practical Sailing*, will prove the Correcter of the *two*. Whateve. might be expected from a *Chart* conſtructed on *Juan*'s (inſtead of one conſtructed from *Murdoch*'s or *Maupertuis*') Principles.

That *unleſs* the Dimenſions of the Earth be *exactly*, or very nearly, determined, and what Sort of a Figure it is, the *Errors* in Navigation from a wrong Figure of the Earth admitted will be greater than thoſe from ſuppoſing it an *exact* Sphere, excluſive of the larger Errors in the *Courſe* and *Diſtance*, that are impracticable to correct, but by cœleſtial *Obſervation*. Nor will the *incorrect* Determination of the Figure of the Earth have a better Effect, in the true Determination of the *Parallaxes* of the Moon, *Beginning*, *Middle*, and *End* of the *Solar* Eclipſes, their Quantity of Duration, the Sun's Parallax by the *Tranſit* of *Venus* over his Diſk, 1761, which will all be a little precarious.

COMPARISON *of different* SPHEROIDAL *with the ſame* SPHERICAL NAVIGATION.

EXAMPLE. Mr. *Murdoch* (and after him Mr. *Martin*) *ſuppoſes a Ship ſails from a Place in* 25° *Latitude South to another in* 30° *Latitude* N. (*the Difference of Latitude* 55°) *on a* Courſe *of* 43° *from the Meridian* (being a Caſe that never happens in the Practice of Navigation) *required the Difference of* Longitude *and* Diſtance *run?*

The Difference of Longitude, by *Mercator*, is	3206′
The Difference of Longitude, by *Murdoch*'s Spheroid, or Figure of the Earth	3141
Difference, *leſs*	65
Diſtance ſailed according to the *Sphere*	4512′
Diſtance ſailed by *Murdoch*'s *Spheroid*	4423
Difference, *leſs*	89
Difference of *Longitude* according to *Juan*'s *Spheroid*	3148
Diſtance ſailed, according to *Juan*	4482
Difference of *Juan*, from *Murdoch*, or *Martin*, in *Longitude*	7+
Diſtance ſailed	59+

Notwithſtanding Mr. Martin'*s pretended* Refinement *of Navigation from* Error, *he, in one Part of his Introduction, ſpeaks thus,* (as if he had *forgot* himſelf) "*It is too well known, how many* Errors *and Miſtakes our moſt ſkilful Seamen* "*are liable to in the Direction of their* Courſe, *their* Diſtance run, *&c.*" — Therefore to agree with M. *Maupertuis*, when all the *Elements* of Navigation are brought to Perfection, it will then be ſeen to what a Degree of Perfection *this Element* of *Spheroidal* Navigation (being applied to Practice) will have among the reſt, the Errors of the *Courſe* and *Diſtance* ſtill remaining.

TO determine (more correctly) the Ratio *of the Diameters of the Earth, from the Meaſure of two different Degrees of Latitude on its Surface, ſuppoſing the Form of the Earth to be that of an* oblate Spheroid?

PUT c = *Semi-Axis*.

t = Semidiameter of the Equator.

M, m the *Meaſures* of a Degree of the Meridian at the given Latitudes of the *Places* P, p.

S, s the *Sines* / S′, s' the *Coſines* } of thoſe Latitudes.

τ' the *Cotangent* of the Latitude P.

r = *tabular* Radius.

$$A=M^{\frac{2}{3}},\quad a=m^{\frac{2}{3}},\quad B=\frac{ass}{ASS},\quad b=\frac{as's'}{AS'S'},\quad N=\frac{A-a}{AS'S'-as's'}rr,\quad n=\frac{A-a}{ass-ASS}rr.$$

$$\text{Whence, } \frac{c}{t}=\sqrt{1+n} \text{ or } =\sqrt{\frac{1}{1-N}},$$

$$\text{or } =\frac{\tau'}{r}\sqrt{\frac{b-1}{1-B}},\ \text{or } =\frac{\tau'}{r}\sqrt{\frac{1-b}{B-1}}.$$

	Latitude.	*Toiſes in Deg. meaſured.*	$\frac{2}{3}$ Roots of which De^s. *Toiſes.*
Ex. *Lapland*	66° 30′	57437,9 = M	1488,672 = $M^{\frac{2}{3}}$
France	49 22	56925,7 = m	1479,811 = $m^{\frac{2}{3}}$
Equator	0 0	56767,8 = m	1477,071 = $m^{\frac{2}{3}}$

By *Lapland* / *France* } $\frac{c}{t}=\sqrt{1+n}=\sqrt{1-,0221728}=\frac{,98885}{1}$

Lapland / *Equator* } $\frac{c}{t}=\sqrt{1+n}=\sqrt{1-,00926618}=\frac{,99535}{1}$.

France / *Equator* } $\frac{c}{t}=\sqrt{1+n}=\sqrt{1-,00321503}=\frac{,99839}{1}$.

⁂ *From the above* variable Ratios *of the Earth's Diameters, deduced* from unerring Rules (*ſuppoſing the Earth to be in the* Form *of a* Spheroid) *it is evident, that either the Earth is not a* Spheroid, *or elſe the Menſurations taken of a Degree at different Places on its Surface are not true.—Hence, the immenſe Expence and Trouble the* French *Nation have been at in taking the ſeveral Menſurations of Arches on the Earth's Surface, are intirely thrown away. And we ſhall at laſt be forced to depend more on the Computations of Sir* Iſaac Newton, *or Mr.* Emerſon, *by the Laws of Gravity. While the different Denſities of the Earth's Subſtance, next its Surface, and towards its Center, (on which that Computation depends) remain uncertain.*

AND HENCE IS PROVED THE ABSURDITY OR UNCERTAINTY OF SPHEROIDAL NAVIGATION! AND CONSEQUENTLY OF ITS BEING AN IDLE OR USELESS REFINEMENT.

For were the true Figure of the EARTH *and* SEA *determined* (which may vary by the Effect of the Moon's Gravity more or leſs at different Times on the Sea) *its Diſcovery would be a greater Advantage to* Geography *than to the* PRACTICE *of* NAVIGATION: *ſince the Spherical Surface of the Earth only conſidered, is ſufficient to anſwer the End of all which Purpoſes.*

Therefore Mrs. MOUNT *and* PAGE *on* Tower-Hill, *may continue the Sale of their* OLD MERCATOR CHARTS *with ſuperior Advantage to any* NEW SPHEROIDAL ONES, *conſtructed (from* Murdoch) doubly erroneous, *when compared with the* Sphere, *and* Juan'*s ſuppoſed truer Spheroid.—For the* Meridional Parts *of the* New Spheroidal Chart *(prematurely or inadvertently made by* B. Martin) *differ* twice *as much from thoſe of the* ſuppoſed truer Spheroid (*laſt recommended for* Practice *in Navigation, by* B. Martin) *as thoſe* truer *differ from the Meridional Parts of the* Sphere.

The

The PROPERTIES *of a* Right-angled PLANE TRIANGLE.

IF *each Side of a right angled* plane Triangle *be made* Radius, *and Circles be described thereto from each End of the Hypothenuse, at the acute Angle, as a Center, then the two Sides, lying contiguous, and third Side lying remote to the same Center, will be the* Natural Secant, Cosine, *and* Sine; Cotangent, Secant, *and* Tangent, *respectively, of the Angle at the Center, included by the* Hypothenuse *and* one Leg; *each of those two Sides being made* Radius.

Or, The *natural* Secant, Cosine, and Sine; Cotangent, Secant, *and* Tangent, *of one Angle (included by the* Hypothenuse *and one* Leg) *under* 45°, *will be the natural* Cosecant, Sine, *and* Cosine; Tangent, Co-secant, *and* Cotangent, *respectively, of the other Angle, above* 45°, *and the* contrary. And therefore these will be proportional to the *Secants, Sines, Tangents,* to the *Radius* in the *Table.*

On this Property *of right-angled* plane Triangles, *the Seaman's* Ready Computers N°. I. II. III. *are founded, by making each Side of a right angled Triangle Radius,* = 10000, *and taking out of the* Tables *for the* 3 *varied* Sides, made Radius, 1, 2, 3, 4, 5, 6, 7, 8, 9 *Times* Radius, Cosine, *and* Sine; Radius, Secant, *and* Tangent; Radius, Cosecant, *and* Cotangent, *correspondent, for all the Angles from* 1 *to* 45 *Degrees; whose Complements, having the same Numbers, from* 45 *to* 90 *Degrees, serve for* 1, 2, 3, 4, 5, 6, 7, 8, 9 *Times the same Complements, or for all the Angles from* 45 *to* 90 *Degrees.*

LET 10000, 20000, 30000, 40000, 50000, 60000, 70000, 80000, or 90000 = Radius.

Correspondent to which the other *two Sides* are set down in *Computers,* N°. I. II. III.

Being found by *Multiplication* of 1, 2, 3, 4, 5, 6, 7, 8, 9 into Natural

Cosine and *Sine* *Tangent* and *Secant* *Cotangent* and *Cosecant*	of an ∠ under 45°.	to *Radius* 10000.

Computer, N°. I.

	Radius.	Other Sides.	
Hypothenuse.	Distance. . . .	Dif. Latitude.	Departure
	Distance. . . .	Departure.	Dif. Latitude.

Computer, N°. II.

	Radius.	Other Sides.	
Longer Leg.	Dif. Lat. . . .	Departure	Distance.
	Depart.	Dif. Lat.	Distance.

Computer, N°. III.

	Radius.	Other Sides.	
Shorter Leg.	Depart.	Dif. Latitude	Distance.
	Dif. Lat.	Departure	Distance.

Some PROPERTIES *of* SINES, TANGENTS, *&c.*

THE *Cosine, Tangent, Cotangent,* and *Secant* are common to two Arches, which are *Supplements* to each other: Yet in an Arc ABOVE A QUADRANT they are *Negative*: being drawn the contrary Way to those of an Arc *less* than a QUADRANT.

In General	*Sine* *Co-versed Sine* *Cosecant*	Affirmative Negative	For all Arcs	under above	180°.
Cosines		Affirmative Negative	fr. 0° to 90°, fr. 270° to 360°. fr. 90° to 270°.		
Tangents.		Affirmative Negative	from 0° to 90°, from 180° to 270°. from 90° to 180°, from 270° to 360°.		
Cotangents		Affirmative Negative	from 0° to 90°, from 180° to 270°. from 90° to 180°, from 270° to 360°.		
Secants.		Affirmative Negative	from 0° to 90°, from 270° to 360°. from 90° to 270°.		
Cosecants		Affirmative Negative	from 0° to 180°. from 180° to 360°.		

Versed Sines . . Affirmative, *in general.*

Sines, *Tangents*, *&c.* of Negative *Arcs* Have contrary *Signs* to those of Affirmative *Arcs.*

For other infinite Properties of Sines, Tangents, &c. consult Mr. EMERSON's TRIGONOMETRY, *who has there exhausted the* Subject, *and left no Room for any Person to make Improvement after him.*

SOME PROPERTIES *of the* SIDES *and* ANGLES *of* PLANE TRIANGLES.

1. As *Sum of Hyp.* and ½ *longer* LEG *of a right angled Triangle is to* 86, so is *the shorter* LEG *to its opposite Angle,* nearly.

2. *a* being the Degrees of the less Angle, it will be,

As $\frac{57.3}{a} + \frac{3a}{1000}$: 1 :: *Hypothenuse* : *Opposite Side to that* ∠, nearly.

3. *a* being the Degrees of the less Angle, it will be,

As 1 : $1 - \frac{1\frac{1}{2}aa}{10000}$ :: *Hypothenuse* : *adjoining Side to that* ∠, nearly.

4. In any right-lined Triangle, As *the Base* : *Sum Sides* :: *Diff. Sides* : *Diff. Segments Base by a Perpendicular.*

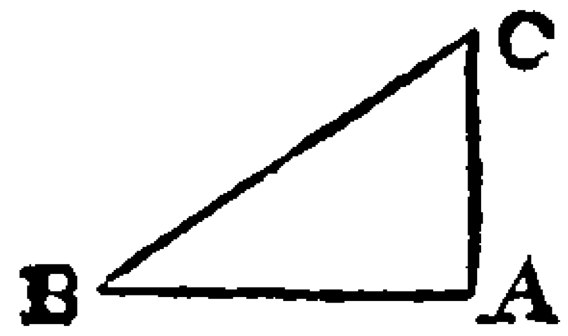
☞ By these 4 Properties, and 47 *Proposition* I. *Euclid,* all the Cases of right-lined Triangles may be solved *without Tables*: letting fall a Perpendicular from the End of given Side, and opposite to a given Angle.

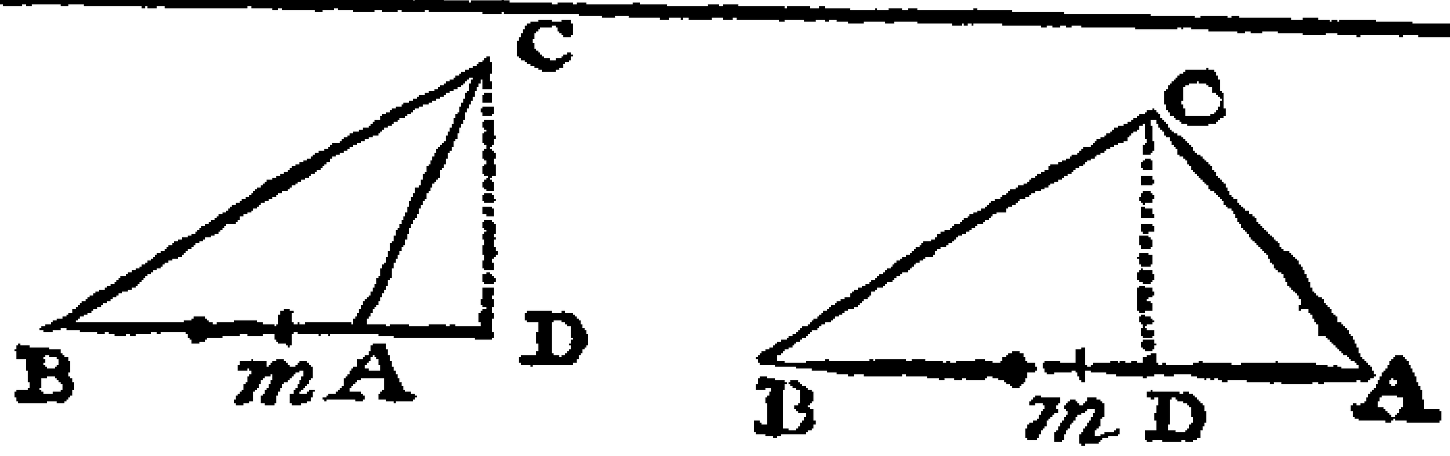
5. In any right-lined Triangle, As *Sum of any two Sides* : *to their Diff.* :: *Tangent* ½ *Sum of their opposite* ∠s : *Tangent* ½ *their Difference.*

6. In any right-lined Triangle, As *twice the Rectangle of the Legs, including an* ∠ : *Sum Squares of the Legs* — *Square Base* :: *Radius* : *Cosine vertical* ∠ *included by the Legs.*

ANSWERS

ANSWERS to all the CASES of PLANE TRIANGLES.





CASES of *Right-angled* PLANE TRIANGLES.

Cases.	GIVEN	SOUGHT	ANSWER. By PROPORTION.
1	*Hyp.* & ∠ BC, B C	*Op. Leg* CA BA Or,	*Rad.* : *Hyp.* :: *s. given* ∠ : *opp. Leg.* R : BC :: *s.* B : CA. *s.* C : BA. *Sec.* ∠ : *Hyp.* :: *t.* ∠ : *opp. Leg.*
2	*Hyp.* & *Leg* BC, CA BA	*Op.* ∠ B C Or	*Hyp.* : *Rad.* :: *Leg* : *s. opp.* ∠. BC : R :: CA : *s.* B. BA : *s.* C. *Leg* : *Rad.* :: *Hyp.* : *Sec. op.* ∠ *to Leg.*
3	*Hyp.* & *Leg* BC, CA BA	*Other Leg* BA CA	*Find the* ∠*s by* Caſe 2. *And then the Leg by* Caſe 1.
4	*Leg* & ∠ CA, B BA, C	*Hyp.* BC Or	*s.* ∠ : *Leg opp.* : *Rad.* : *Hyp.* *s.* B : CA :: R : BC. *s.* C : BA. *Rad.* : *Leg* :: *ſec. adj.* ∠ : *Hyp.*
5	*Leg* & ∠ CA, B BA, C	*Other Leg* BA CA Or	*s.* ∠ : *opp. Leg.* :: *s. other* ∠ : *op. Leg.* *s.* B : CA :: *s.* C. : BA. *s.* C : BA :: *s.* B : CA. *Rad.* : *Leg* :: *t. adj.* ∠ : *other Leg.*
6	*Legs* BA, CA	∠ B C	*One Leg* : *Rad.* :: *other* : *t. op.* ∠. BA : CA :: R : t. B } *Complements of* CA : BA :: R : t. C } *one another.*
7	*Legs* BA, CA	*Hyp.* BC	*Find the* ∠*s by* Caſe 6. *Then the Hyp. by* Caſe 4.

EACH 4 of the following *Terms*, in the ſame *Rectangle* are proportional, read from Left to Right, or from Right to Left: Shewing the Variations of anſwering trigonometrical *Caſes by the Tables.*

Radius : *Sine* : *Coſine*
Secant : *Tangent* : *Radius*
Coſecant : *Radius* : *Cotangent*

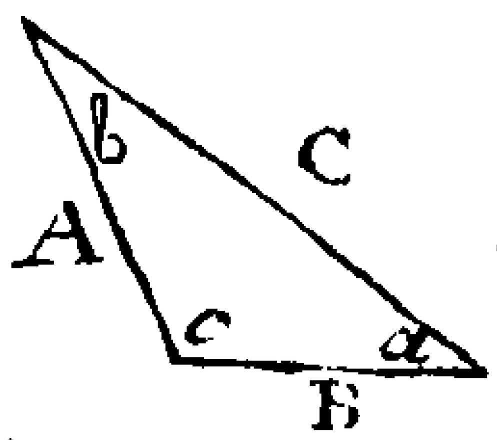
} *N. B. Any two* of theſe Proportionals may be put in the Room of any other two *like* Proportionals.

Thus, As Rad. : *s.* given ∠ ::
Or, As Sec. : t. given ∠ ::
Coſec. : Radius ::

} Hyp. : opp. Leg to the given ∠.

The above *like Proportionals* may be alſo varied in the Solution of ſpherical Triangles further on, by Lord *Napier*'s *Propoſition.*

UNIVERSALLY.



IN any right-lined Triangle, whoſe Sides are repreſented by A, B, C, and oppoſite Angles by *a*, *b*, *c*, any three of the ſix Terms being given, (except the 3 Angles) the Reſt are thus determined.

CASE I. *When there is a Side and* ∠ *op. given.*

Then $\frac{A}{s.\,a} = \frac{B}{s.\,b} = \frac{C}{s.\,c}$, whence the *Term* reqd. is had.

☞ When two Sides A, B, and an ∠ oppoſite to one of them A is given, if A is leſs than B, then *b*, *c*, and C have each two Values. If A is greater than B, then *b*, *c*, and C have but one Value.

CASE II. *Two Sides* (A the greater, B the leſs) *and an Angle* c *included are given.*

Put $D = \frac{180^\circ - c}{2}$, and $\frac{A - B}{A + B} \times t.\,D = t.\,E.$

Then $a = D + E$, and $b = D - E$.

Likewiſe, Put L. 2A + L. 2B + 2L. *s.* ½*c* — 20.0000000 = L. F. and 2L. $\overline{A - B}$ = L. G: Then ½ L. $\overline{F + G}$ = L. C, the 3d *Side*, reqd.

N. B. If the included ∠, *c*, is 90°,

Then, $t.\,a = \frac{A}{B} \times r$; $t.\,b = \frac{B}{A} \times r$; and $C = \frac{s.\,a}{r} \times A$, or $= \frac{s.\,b}{r} \times B.$

N. B. *s*, *t*, *r*, and L, denote *Sine*, *Tangent*, *Radius*, and *Logarithm.*

CASES of *Oblique* PLANE TRIANGLES.

Cases.	GIVEN.	SOUGHT	ANSWER. By PROPORTION.
1	∠*s* & *a Side* A, B, BCA, [BC.	*Other Sides* BA CA	*s.* ∠ : *op. Side* :: *s. other* ∠ : *op. Side.* *s.* A : BC :: *s.* BCA : BA. *s.* B : CA.
2	2 *Sides* & ∠ *oppoſite to one* BC, CA, A B	*Other* ∠*s* B A BCA	*Side* : *s. op.* ∠ :: *Side* : *op.* ∠. BC : *s.* A :: CA : *s.* B. CA : *s.* B :: BC : *s.* A. *Now*, two ∠s known, their Sum fr. 180° leaves the 3d ∠ BCA.
3	2 *Sides* & ∠ *oppoſite to one* BC, CA, A B	*Other Side* AB	*Find* ∠ *oppoſite Side required by* Caſe 2. *Then the required Side by* Caſe 1. *s.* A : BC :: *s.* BCA : AB. *s.* B : CA :: *s.* BCA : AB.
4	2 *Sides and* ∠ *included* BA, BC, B	*Other* ∠*s* BCA, A	*Sum Sides* : *their Dif.* :: *Tan.* ½ *Sum op.* ∠*s* : *Tang.* ½ *their Difference.* Which *added* to and *ſubtracted* from the ½ Sum gives the 2 *Angles* required.
5	2 *Sides and* ∠ *included* BA, BC B	*The other Side.* CA	*Find the* ∠*s by* Caſe 4, *and then the ſought Side* CA *by* Caſe 1.
6	3 *Sides* BA, BC, CA	∠ *oppoſite to one Side.* A.	Let *fall Perp.* CD *oppoſite* ∠ *required.* Then, *Baſe* : *Sum Legs* :: *Dif. Legs* : *Dif. Segments Baſe*, BD — DA, *where the Perpendicular* CD *falls*, ½ *which Diff.* = *m*D, added to and ſubtracted from half the Baſe gives the Segments BD, and DA. Whence ∠ A is found by *Caſe* 2d of Right-angled Triangles.

CASE III.

FROM the 3 SIDES given, A, B, (including a required ∠, *c*) and C the Side oppoſite to a required Angle, this Angle may be found *thus.*

RULE. *Add the* 3 *Sides together, and take the* ½ *Sum thereof, and ſet down its* co. Logarithm. *Under which ſet down the* co. Logarithm *of the Difference between which half Sum and the Side oppoſite to the required Angle, and then ſet down the* Logarithms *of the Differences between which* Half Sum *and the other* two Sides; *the Half Sum of which* four *Numbers will be the* Logarithm Tangent *of Half Angle, required.*

Thus, If $\frac{A + B + C}{2} = H$ . . . . . . co. Log.
H — C Side oppoſite ∠ required . . co. Log.
H — A . . . . Log.
H — B . . . . Log.

½ ∠ reqd. . . . . Log. Tang. ½ Sum.
Doubled the ∠. *See Page* 116 *for Example.*

For, H × H — C : H — A × H — B :: 1 (Rad. ſq.) t^2, ½ ∠.
Alſo, AB : H — A × H — B :: 1 (Rad. ſq.) s^2, ½ ∠.

HENCE this RULE. *To the* Log. *Complements of the Sides* including *the ſought Angle, add the* Logarithms *of the Difference between the* Half Sum *of all the* 3 *Sides and* each *of theſe including Sides, the half Sum of thoſe* 4 *Numbers will be the* Log. Sine *of* half *the ſought Angle.*

Thus, A, including Side . . . . co. Log.
B, including Side . . . . co. Log.
H — A . . . . Log.
H — B . . . . Log.

½ ſought ∠ . . . . Log. Sine ½ Sum.
Doubled the ∠.

RULES for anſwering all the CASES of SAILING.

PROPORTIONS for the Five CASES of PLAIN SAILING.

1. As Radius : *Diſtance run* :: *Sine Courſe* : *Departure*. Or, *Sec. Courſe* : *Diſtance run* :: *Tan. Courſe* : *Departure*. Or, *Coſec. Courſe* : *Diſtance run* :: *Radius* : *Departure*.
2. As *Radius* : *Diſtance run* :: *Coſ. Courſe* : *Diff. Latitude*. Or, *Sec. Courſe* : *Diſtance run* :: *Radius* : *Diff. Latitude*. Or, *Coſ. Courſe* : *Diſtance run* :: *Cot. Courſe* : *Diff. Latitude*.
3. As *Radius* : *Diff. Latitude* :: *Tang. Courſe* : *Departure*. Or, *Coſ. Courſe* : *Diff. Latitude* :: *Sine Courſe* : *Departure*. Or, *Cot. Courſe* : *Diff. Latitude* :: *Radius* : *Departure*.

PROPORTIONS for the Three CASES of PARALLEL SAILING, directly EAST or WEST.

4. As *Coſ. Latitude* : *Diſt. 2 Places in 1 Parallel* :: *Radius* : *Diff. Longitude*. Or, *Radius* : *Diſt. 2 Places in 1 Parallel* :: *Sec. Lat.* : *Diff. Longitude*. Or, *Cot. Latitude* : *Diſt. 2 Places in 1 Parallel* :: *Coſec. Latitude* : *Diff. Longitude*.

☞ HENCE, The Length of a Degree of Longitude in any Parallel of Latitude is as the Coſine of the Latitude to Radius; or, as Radius to Sec. Latitude; or as Cot. to Coſec. Latitude.

PROPORTIONS for the Five CASES of MIDDLE LATITUDE SAILING, where the LONGITUDE is concerned.

An APPROXIMATION of MERCATOR SAILING.

5. As *Coſ. Mid. Latitude* : *Departure* :: *Radius* : *Dif. Long. nearly*. Or, *Radius* : *Departure* :: *Secant Mid. Lat.* : *Dif. Longitude*. Or, *Cot. Mid. Latitude* : *Departure* :: *Coſec. Mid. Lat.* : *Dif. Longitude*.

SINCE the Product of the two Extremes is equal to the Product of the two middle Terms, in any Proportion, therefore ſubſtituting in the 5th Proportion *Diſt. run* × *Sine Courſe* = *Radius* × *Departure*, in 1ſt Proportion, and we have,

6. As *Coſ. Mid. Latitude* : *Diſt. run* :: *Sine Courſe* : *Dif. Longitude*.

Again, ſubſtituting in the 5th, Dif. Lat. × Tang. Courſe = Radius × Departure, in 3d Proportion, and we have,

7. As *Coſ. Mid. Latitude* : *Dif. Latitude* :: *Tang. Courſe* : *Dif. Longitude*.

N. B. If you take Half the *Sum* of the natural Coſines of the two Latitudes, and uſe the Latitude anſwering thereto, for middle Latitude, the Proportion will (*according to Mr.* Emerſon, *P. 71 of his Navigation*) be more exact.

PROPORTIONS for the Five CASES of MERCATOR-SAILING, where the LONGITUDE is concerned.

8. As *proper Dif. Lat.* : *Meridional Dif. Lat.* :: *Departure* : *Diff. Longitude*.

By Sim. △s. By 3d. As Rad. : Tang. Courſe :: Dif. Lat. : Departure. And ſubſtituting the *former* for *latter Ratio*, in the 8th, we have as follows.

9. As *Radius* : *Meridional Dif. Lat.* :: *Tang. Courſe* : *Diff. Longitude*.

N. B. The Mercator-Sailing Triangle is ſimilar to and contains the plain-ſailing Triangle: being both repreſented by Right-Lines.

GENERAL PROPORTION.

10. As *Tang.* 51° 38′ 9″ : *Tang. Courſe* :: *Dif. Log. Tangents ½ Complements of Latitude from the ſame Pole* (eſteeming the 3 laſt of 7 Figures Decimals and the reſt whole Numbers) . . . . : *Diff. Long.*

This Proportion, with the 1ſt, anſwer all the Caſes of Sailing.

☞ Both Latitudes and the Diſtance being given to find the Difference of Longitude, *the Courſe* muſt firſt be found by *plain Sailing*.

Or, One Latitude being given and the Difference of Longitude required, the other Latitude muſt firſt be found by *plain Sailing*, before the Longitude can be found.

GENERAL EQUATIONS.

IF a, b, denote *the Latitudes of two Places*, a', b', *their Diſtances or Complements from the ſame Pole*; A, B, *the Log. Tangents of* $\frac{1}{2}a'$, $\frac{1}{2}b'$; m = *Dif.* A *and* B; M = *Log.* m; T = *Log. Tang. of the Ship's Courſe, or Rhumb*, c; l = *Difference of Longitude of the two Places*; L = *Log. of* l; N = 3,8984896; R = 10.0000000.

Then, 1. $R + L = M + N + T$, will be the Relation between the *Latitudes*, *Difference of Longitude*, and *Bearings* of thoſe Places.

Alſo, Putting d = Diſtance of the two Places, D = Log. d; δ = Dif. Latitudes, $\triangle$ = Log. δ.

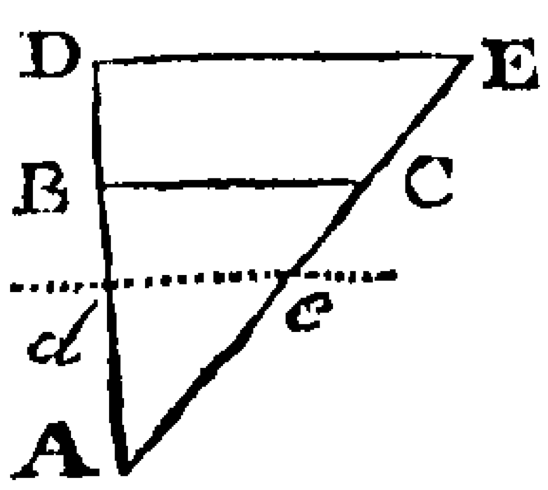
C = Log. Coſine c; C′, M′, N′, arithmetical Complements of C, M, N.

And, 2. $D + C = R + \triangle$. By which two EQUATIONS all Caſes in Sailing are anſwered, where no Departure is concerned.

N. B. *Where a Log. is to be* ſubtracted, *in the foregoing Equations, take its arithmetical Complement inſtead thereof and* add it.

The GROUNDS of MERCATOR-SAILING, either by *Meridional* PARTS of the SPHERE or SPHEROID.

ABC is a *plain-ſailing* Triangle } *both*
ADE a *Mercator-ſailing* Triangle } *ſimilar*.
AB = proper Dif. Latitude; BC = Departure, AC = Diſtance run.
AD = Merid. Dif. Latitude of two Places A and B.
DE, Part of the Equator, = Dif. Longitude ∠ DAE the Courſe.
Hence AB : BC :: AD : DE.



N. B. *If the Mer. Parts for Dif. Latitudes* A *and* B, *be greater than the Mer. Parts for* A; *the Latitude given, deduct the leſs fr. greater, for Mer. Parts of* B, *on the contrary Side of Equator* &c.

Or, Dif. Lat. : Departure :: Merid. Dif. Latitude : Dif. Longitude . . 8th *Proportion*; whence 9th *Proportion deduced*.
For, AD : DE :: Rad. : Tan. DAE, i. e. *Merid. Dif. Lat.* : *Dif. Long.* :: *Rad.* : *Tangent Courſe*.
Hence the following Table is compoſed.

TABULAR RULES for anſwering all the CASES of SAILING.

A TABLE of the 6 PLAIN SAILING CASES. — In WORDS.

Caſes.	Given.	Sought	ANSWER.	Given.	Sought.	ANSWER.
1	*c d*	δ *e*	Rad. : coſ. *c* :: *d* : δ . . by 2 Proportion. Rad. : ſin. *c* :: *d* : *e* 1	*Courſe* *Diſtance*	Dif. Lat. Departure	As *Rad. to Coſ. Courſe ſo Diſt. to Dif. Lat.* *Rad. to ſin. Courſe ſo Diſt. to Depart.*
2	δ *e*	*c* *d*	δ : *e* :: Rad. : tan. *c* . . . 3 Sin. *c* : *e* :: Rad. : *d* . . . 1	*Diſt. Lat.* *Departure*	Courſe Diſtance	*Dif. Lat. to Depart. ſo Rad. to Tan. Courſe.* *Sin Courſe to Depart. ſo Radius to Diſt.*
3	*c e*	δ *d*	Tan. *c* : *e* :: Rad. : δ . . . 3 Sin. *c* : *e* :: Rad. : *d* . . . 1	*Courſe* *Departure*	Dif. Lat. Diſtance	*Tan. Courſe to Depart. ſo Rad. to Dif. Lat.* *Sine Courſe to Depart. ſo Rad. to Diſt.*
4	δ *d*	*c* *e*	*d* : Rad. :: δ : coſ. *c* . . . . 2 Rad. : Sin. *c* :: *d* : *e* . . . 1	*Dif. Lat.* *Diſtance*	Courſe Departure	*Diſtance to Rad. ſo Dif. Lat. to Coſ. Courſe.* *Rad. to Sine Courſe ſo Diſt. to Depart.*
5	*c* δ	*d* *e*	Coſ. *c* : Rad. :: δ : *d* . . . 2 Rad. : tan. *c* :: δ : *e* . . . 3	*Courſe* *Dif. Lat.*	Diſtance Departure	*Coſ. Courſe to Rad. ſo Dif. Lat. to Diſt.* *Rad. to Tan. Courſe ſo Dif. Lat. to Depart.*
6	*d e*	*c* δ	*d* : Rad. :: *e* : ſin. *c* . . . 1 Rad. : *d* :: coſ. *c* : δ . . . 2	*Diſtance* *Departure*	Courſe Dif. Lat.	*Diſt. to Radius ſo Depart. to Sine Courſe.* *Rad. to Diſt. ſo Coſ. Courſe to Dif. Lat.*

c denotes *Courſe*, d *Diſtance run*, δ *Difference of Latitude*, e *Departure*.

A TABLE of the 3 PARALLEL SAILING CASES. — In WORDS.

Caſes.	Given.	Sought	ANSWER.	Given.	Sought.	ANSWER.
1	*a l*	*d*	Rad. : coſ. *a* :: *l* : *d* . . by 4	*Latitude* *Dif. Long.*	Diſtance.	*Rad. to Coſ. Lat. ſo Diff. Long. to Diſt.*
2	*a d*	*l*	Coſ. *a* : Rad. :: *d* : *l* . . . 4	*Latitude* *Diſtance*	Longit.	*Coſ. Lat. to Rad. ſo Diſt. to Dif. Long.*
3	*d l*	*a*	*l* : *d* :: Rad. : coſ. *a* . : . 4	*Diſtance* *Dif. Long.*	Latitude.	*Dif. Long. to Diſt. ſo Rad. to Coſ. Lat.*

a denotes the Parallel of Latitude, *l* Difference of Longitude, and *d* the Diſtance of two Places in that Parallel.

A TABLE of the 7 CASES of Middle LATITUDE and MERCATOR SAILING, concerning LONGITUDE. — In WORDS.

Caſes.	Given.	Sought	ANSWER.	Given.	Sought.	ANSWER.
1	*a, b, l*	*c* *d*	δ : *l* :: coſ. μ : tan. *c* . . . . 7 λ : Rad. :: *l* : tan. *c* . . . . 9 *m* : Tan. 51° 38′ 9″ :: *l* : tan. *c* . . 10 T = M′ + L + N′ + R ; D = Δ + C′ + R. By Equations 1 and 2. Coſ. *c* : Rad. :: δ : *d* : *Caſe* 5 *plain Sailing.*	*Two Lats.* *Dif. Long.*	Courſe Diſtance	*Dif. Lat. to Dif. Lon. ſo coſ. mid. Lat. to tan. Crſe* *Mer. Dif. Lat. to Rad. ſo Dif. Lon. to Tan. Courſe* *Dif. Log. Tangents ½ Comps. Lats. : Tan. 51° 38′ 9″ :: Dif. Long. : Tan. Courſe.* *Coſ. Courſe to Rad. ſo Dif. Lat. to Diſt.*
2	*a, b, c*	*l* *d*	Coſ. μ : tan. *c* :: δ : *l* . . . . 7 Rad. : tan. *c* :: λ : *l* . . . . 9 Tan. 51° 38′ 9″ : tan. *c* :: *m* : *l* 10 L = M + N + T − R. By *Equation* 1. *d* as above.	*Two Lats.* *Courſe*	Dif. Long. Diſtance	*Coſ. mid. Lat. to tan. Courſe ſo Dif. Lat. to Dif. Lon.* *Rad. to Tan. Courſe ſo mer. Dif. Lat. to Dif. Lon.* *Tan. 51° 38′ 9″ to Tan. Courſe ſo Dif. Log. Tangents ½ Comps. Lat. to Dif. Long.* The Diſt. is found as above, *by Caſe* 5. *pl. Sail.*
3	*a, b, d*	*c* *l*	*c* found by *Caſe* 4. *plain Sailing.* *l* found as by 2. *Caſe*, Mercator.	*Two Lats.* *Diſtance*	Courſe Dif. Long.	Courſe found as above by *Caſe* 4. *plain Sailing.* Then Dif. Long. found by 2 *Caſe*, *Mercator.*
4	*a, c, l*	*b* *d*	Tan. *c* : coſ. *a* (for mid. Lat.) :: *l* : δ ; by which find mid. Lat. and repeat the Operation for the other Latitude. Tan. *c* : Rad. :: *l* : λ, ſubtract or add which Parts from or to thoſe of other Latitude for Latitude correſpondent. Tan. *c* : *l* :: tan. 51° 38′ 9″ : *m* . . . 10 Which added to Tan. ½ Comp. given Lat. gives the other Latitude. M = L + N′ + T′ + R. Here *m* and *b* found. *d* found by *Caſe* 5 *plain Sailing.*	*One Lat.* *Courſe* *Dif. Long.*	Other Lat. Diſtance	*Tan. Courſe to Coſ. given Lat. ſo Dif. Lon. to Dif. Lat.* by this find mid. Lat. and repeat the Operation to get the other Latitude. *Tan. Courſe to Rad. ſo Dif. Lon. to mer. Dif. Lat.* ſubtract or add which Parts from or to thoſe of the other Lat. and find the Latitude correſponding. *Tan. Courſe to Dif. Lon. ſo Tan.* 51° 38′ 9″ *to Dif. Log. Tangents ½ Comps. Latitudes*, which added to the tan. ½ Comp. given Lat. gives the other. Diſt. is now had by *Caſe* 5. *plain Sailing.*
5	*a, c, d*	*b* *l*	δ is found and *b* by *Caſe* 1. *plain Sailing.* *l* is found now by 2 *Caſe Mercator.*	*One Lat.* *Courſe. Diſt.*	Other Lat. Dif. Long.	Dif. Lat. and other Lat. find by *Caſe* 2. *pl. Sail.* Now, Dif. Long. is found by 2 *Caſe Mercator.*
6	* *a, d, l*	*c* *b*	Aſſume *c*, by which find δ, *b*, and *e*, till (*by Trial and Error*) δ : *e* :: λ : *l*. *If meridional Parts of Dif. of Latitudes are greater than thoſe for Lat. given, deduct the leſs from greater for merid. Parts to Latitude on contrary Side of Equator.*	*One Lat.* *Diſtance* *Dif. Long.*	Courſe and other Lat.	Aſſume a *Courſe*, by which find Dif. Lat. other Lat. and Dep. till (*by Trial and Error*) *Dif. Lat. to Depart. ſo Mer. Dif. Lat. to Dif. Longitude.* The *direct Method* of ſolving this Caſe by one *Rubes* or *Rebus*, P. 64. *Pal.* 1759, is not true.
7	* *c, d, l*	*a* *b*	Aſſume *a*, and thence find *b*, till (*by Trial and Error*) δ : *e* :: λ : *l*. ☞ The above are all eaſily anſwered by Computers I. II. III.	*Courſe* *Diſtance* *Dif. Long.*	Both the Latitudes	Aſſume one Latitude, and find thence the other, till (*by Trial and Error*) *Dif. Lat. to Dep. ſo Mer. Dif. Lat. to Dif. Longitude.*

μ denotes Middle Latitude, λ the Meridional Difference of Lat.

* The 6th and 7th Caſes above are not taken Notice of before by any Writer on Navigation. *No Solutions were ever given to them.*

Mr. *B. Martin* has repreſented the 6th as *impoſſible*, in his *Spheroidal Navigation.*

N. B. The *Caſes* of the *Departure* in *Mercator*, here omitted, may be anſwered by meridional Difference of Latitudes, and the 8th Proportion foregoing.

EXAMPLES of anſwering the PRINCIPAL CASES of MERCATOR-SAILING. According to different METHODS.

1. GIVEN a, b, l; *To find* c, d? *Here* $T = M' + N' + L + R$; And $D = \Delta + C + R$.

By LOGARITHMIC EQUATIONS.

EXAMPLE. *Required the Bearing and Diſtance of the Iſland of St.* Vincent, *(one of the* Cape de Verd *Iſlands) in* Latitude 17° 4′ N. Longitude 24° 44′ W. *of* Greenwich, *from the* Lizard Point, *in* Latitude 49° 55′ N. Longitude 5° 19′ W. *of* Greenwich.

$a = 17^\circ\ 4'$; $a' = 72^\circ\ 56'$; $\frac{1}{2}a' = 36^\circ\ 28'\ 0''$ — Logarithms. $A = 9.8686864$
$b = 49\ 55$; $b' = 40\ \ 5$; $\frac{1}{2}b' = 20\ \ 2\ \ 30$ — $B = 9.5624477$

$\delta = 32\ 51 = 1971'$ or Miles. — $m = 0.3066327$
$l = 19\ 25 = 1165$

$\Delta = 3.2946166$ — $M' = 0.5133816$
$C' = 0.0450185$ — $N' = 6.1015104$
$L = 3.0663259$
$R = 10.0000000$

$D = 3.3397051$
$d = 2186',277$ Miles; $c = 25^\circ\ 38'\ 23''$ W $= T = 9.6812179$

By DIFFERENCE of LOGARITHM TANGENTS.

	Logarithms.
As Dif. Log. Tangents $\frac{1}{2}$ Complements of Latitudes 36° 28′ and 20° 2′ 30″; 3066,327	co. 6.5133816
To Dif. Long. 32° 51′ = 1971′ Miles	3.0663259
So Tang. conſt. ∠ 51° 38′ 9″	10.1015104
To Tang. Courſe 25° 38′ 23″ W.	9.6812179

d is found as before.

By COMPUTER, Number II.

Courſe.	Dif. Lat.	Diſt.	
25° 38′	1000	1109.2	But taking to the
	900	998.29	*neareſt* Courſe in *whole*
	70	77.64	Degrees will be ſuffi-
	1	1.00	cient.
	1971	2186.13	*Diſtance.*

By MERIDIONAL PARTS.

Lat.	Merid. Parts.		
49° 55′	3466,5	As Mer. Dif. Lat. 2427,5	co. 6.6148408
17 4	1039,	To Dif. Long. 1165′	3.0663259
		So Radius	10.0000000
32 51 Dif. Lat.	2427,5 Mer. Dif. Lat.	To Tan. Courſe 25° 38′	9.6811667

By COMPUTER, Number II.

2427,5)1165(,4800 nearly, Quote, againſt which is Courſe 25°38′; according to the *Mercator-Triangle.*

OR, By COMPUTER, Number II.

Againſt 26° *Courſe,* and 1971 Dif. Lat. you take out 2192 Miles Diſtance; being but 6 Miles *too much* in 32° 5′ *Dif. Latitude.*

2. GIVEN a, b, c; *To find* l, d? *Here* $L = M + N + T - R$; And $D = \Delta + C' + R = D$.

By LOGARITHMIC EQUATIONS.

EXAMPLE. *From the* Latitude 49° 55′ N. Longitude 5° 19′ W. *a Ship ſails on a Courſe* S. 25° 38′ 23″ W. *until, by Obſervation, ſhe finds herſelf in* Latitude 17° 4′ N. *Required her* Latitude *and* Diſtance *run.*

$a = 17^\circ\ 4'$; $a' = 72^\circ 56'$; $\frac{1}{2}a' = 36^\circ 28'\ 0''$ — $A = 9.8686804$
$b = 49\ 55$; $b' = 40\ \ 5$; $\frac{1}{2}b' = 20\ \ 2\ \ 30$ — $B = 9.5620477$

$\delta = 32\ 51 = 1971'$; $\Delta = 3.2946866$ — $m = 0.3066327$
$R + C' = 0.0450185$

Miles. — $M = 9.4866184$
$d = 2186,277$ …. $D = 3.3397051$ — $N = 3.8984896$
Long. went fr. 5° 19′ — $T = 9.6812179$
Diff. Long. 19 25 $= l = 1165$ Miles $= L = 3.0663259$
Ship's Long. 24 44

By DIFFERENCE of LOGARITHM TANGENTS.

As Tan. conſ. ∠ 51° 38′ 9″	co. 89.8984896
To Tan. Courſe 25° 38′ 23″	9.6812179
So Dif. Log. Tangents $\frac{1}{2}$ Comps. Lats. 36° 28′ and 20° 2′ 30″; 3066,327	3.4866184
To Diff. Long. 32° 51′ = 1971 Miles	3.0663259

d is found as before.

OR, By COMPUTER, Number II.

Againſt 26° Courſe, and 2427 Mer. Dif. Lat. you take out 1183′ or 19° 43′ Depart. for Dif. Long. but 18′ too much in about 33° Dif. Lat. Sailing.

By MERIDIONAL PARTS.

Lat.	Mer. Parts.		
49° 55′	3466.5	As Radius	10.0000000
17 4	1039.	To Mer. Dif. Lat. 2427,5	3.3851592
		Tang. Courſe 25° 38′ 23″	9.6812179
32 51 Dif. Lat.	2427.5 M. Dif. Lat.	To Dif. Long. 1165′	3.0663771

By COMPUTER, Number II.

Courſe.	Mer. D. Lat.	Dep. for Dif. Long.	
Againſt 25° 38′	2000	959.77	or 19° 25′ reqd.
	400	191.94	
	20	9.60	
	7	3.43	
	2427	1164.74	Dif. Long.

3.

3. GIVEN *b*, *c*, *d*; *To find a, l?* *Here* $\triangle = D + C - R$, whence *a* and *m* are found; And $L = M + N + T - R$.

EXAMPLE. *From the* Latitude 49° 51′ N. *and* 5° 19′ W. *from* Greenwich, *a Ship runs on a Course* S. 25° 38′ 23″ W. 2186′,277 *Miles: Required from thence the* Latitude *and* Longitude *arrived in?*

By LOGARITHM EQUATIONS.

	$d = 2186{,}277.$	$D = 3.3397051$
Lat. sailed from 49° 55′ N.	$c =$ S. 25° 31′ 23″ W.	$C = 9.9549815$
Diff. Latitudes 32 51 N	$= \delta$ 1971 Miles, . . .	$\triangle = 3.2946866$
Ship's Latitude 17 4 N.		
$a = 17°\ 4'$; $a' = 72°56'$; $\frac{1}{2}a' = 36°\ 28'\ 0''$		$A = 9.8686804$
$b = 49\ 55$; $b' = 40\ \ 5$; $\frac{1}{2}b' = 20\ \ 2\ 30$		$B = 9.5620477$
		$m = 0.3066327$
		$M = 9.4866184$
		$N = 3.8984896$
		$T = 9.6812179$
Long. sailed from 5° 19′		
Diff. Long. 19 25	$= l = 1165$ Miles;	$L = 3.0663259$
Ship's Long. 24 44 arrived in.		

By DIFFERENCE of LOGARITHM TANGENTS.

Find the Difference of Latitude = 32° 51′ N. and Ship's Latitude 17° 4′ N. arrived in, by *Plain-Sailing*, as on the Right-Hand.

Then find the *Difference of Longitude* as in the former Example, by proportioning the Difference of Logarithm-Tangents of the Half Complements of Latitudes.

☞ *The Course and meridional* Difference of Latitude *being found as in the former Example, the Difference of Longitude follows as in that Example, by proportioning the meridional Parts, and also by the* COMPUTER.

All other Cases occurring in Practice, (except the 6th and 7th) *are reducible to the foregoing; by which the* Dead-Reckoning *of a Ship* (as it is called) *may be duly kept, and corrected as follows by frequent Observation of the* Latitude.

N. B. *By the* daily Course *and meridional* Difference of Latitude, *(allowing for* Lee-Way, Variation, Setting of Currents, &c.) *you may take out the* daily Difference of Longitude, *from* Computers Number II. *or* III. *without taking Departure into the Reckoning, except you please: Which* Departure *may be readily taken out from the* proper Difference of Latitude *and Course given.*

Of correcting the SHIP's COURSE steered by the COMPASS.

CORRECTION of the Ship's Course by the *Magnetical* VARIATION.

THE Difference between the Sun's *magnetical* Amplitude, taken by the Compass, at his Rising (or Setting) and his *apparent* Amplitude at Rising (or Setting) by *Tab. p.* 204 *to* 208, is the magnetical Variation, E. or W. to be allowed for the same Way, or to the *Right* or *Left* of the Course *steered by the Compass,* for the Ship's *true Course.*

The *magnetic* Variation is likewise found by two magnetical Azimuths, taken at equal Altitudes of the Sun, on the *same Day.* This whole magnetical Arch being *bisected,* the *Middle* thereof will give you the true South or Meridian very *nearly;* which will shew the Difference, or Variation, E. or W. from the true Meridian, or South Point of the Compass: which is to the *Right* or *Left* thereof, respectively.

The *magnetical Variation* is *otherwise* determined by the *Azimuth*-Compass, and a *Plumb Line* with some *Star* coming to the Meridian at a given Time of the Night, which will shew the Difference between the *true* and *magnetical* Meridian.

This Variation, at *London,* has altered as follows.

	Year	Variation.
At *London* in	1580	11° ¼ E.
	1657	Northerly.
	1723	12° W.
	1759	15° W.

Now (in 1759) it proceeds westerly at *London,* about 1 Degree in 7 Years. In some Places it moves *Eastward;* in others it is without Motion. The Changes of Variation is also different in different Places.

See Mr. Emerson's *Table of Variation, Page* 49. *of his Navigation.*

There are Tables of magnetical Variation in *Philos. Transactions,* and elsewhere, not to be depended on; because there is continual Change of Variation in most Places.

FURTHER CORRECTION of the SHIP's COURSE by *allowing* for LEE-WAY.

THE Ship falling off from the *Course steered by the Compass,* by several Causes and Impediments to continue that Course, especially the Impediment of *Lee-Way,* her Course by the Compass must therefore be rectified by allowing for *Lee-Way,* as follows.

Rule 1. Set the Ship's *Wake* by the *Compass,* and the Angle betwixt it and the Ship's *Keel* (or right *Fore* and *Aft*) is her Lee-Way, if there is no Current: for so much she falls off from her Course (steered) to the *Leeward,* or from the Wind.

Rule 2. Being within Sight of *Land,* the Angle taken betwixt the Ship's Keel (or right *Fore* and *Aft*) and that *Point of Land* always bearing on the same Point of the Compass, will be the Lee-way made by the Ship, or what she falls off from her *Parallel,* while she steers the same Course by the Compass.

REMARK. Different Ships make different *Lee-Way,* caused by the Difference of their *Hulls* in Building. Nor, as *Ship-Builders* allow, can any two Ships be built to sail alike for *Swiftness:* And Experience of Sailing in any one

Of correcting the SHIP's COURSE steered by the COMPASS.

Ship will best determine her *Lee-Way* under certain Circumstances of *Wind, Sails set, Seas*, and *Weather*. A high Sea, or great Swell a-cross the Course steered by the Compass, produce large *Lee-Way*; requiring sometimes much Skill and Experience to determine its Quantity: A Ship being out of *Trim*, or drawing more or less Water, affect her *Lee-Way*.

GENERAL RULES of LEE-WAY from the SAILS *set*, or *furled*.

1. *A Ship upon a Wind with all Sails set*, 1 *Point Lee-Way*.
2. *Top-Sails reefed*, 1 *Point* $\frac{1}{2}$.
3. *Hard Wind, one Topsail in*, 2 *Points*.
4. *High Sea, hard Gales, both Topsails furled*, 3 *Points*.
5. *Only Mainsail and Mizen set*, 4 *Points*.
6. *Only Mainsail out*, 5 *Points*.
7. *Only Mizen set*, 6 *Points*.
8. *All Sails furled*, 7 *Points*.

☞ SOME *Seamen* make different Allowances, but these are the most common, when, in a dark Night, or great Sea, a Ship's *Wake* cannot be set. How *fruitless* then is *Spheroidal Navigation*, when so great *Difficulty*, *Doubts*, and *Difference* frequently arise in adjusting the true Course of the Ship.

N. B. Hard Gales and high Seas setting with or against the Ship's Motion, varies the *Lee-Way*, more or less, of which Experience can only judge.

FURTHER CORRECTION of the Ship's COURSE, and also DISTANCE, by trying the SWIFTNESS and Setting of a CURRENT.

WHEN there is *little* Wind and a *smooth* Sea, a Ship's *Current* is tried by the known Methods in Practice, as follows.

You *sink* (out of a Boat, at a small Distance from the Ship, where the Current is) a large triangular Board, leaded on one Side, an *Iron Pot*, or a *Kettle*, below the Current, with a *Line* tied properly to either 60, 80, 100, or more Fathoms in Length, to be veered out into the Sea, at one End, to give the *Sinker* Depth enough below the Current; and then the End of the *Line* in Hand is fastened to the Boat's *Stern*, to bring her up, as if she were at Anchor; and keep her as steady as possible upon the Top of the Current.

NOW, *heaving* your Log, and turning your *Half-Minute-Glass*, you set the *Drift* of the Log, upon the Current, by the Compass, when the Length of the *Log-Line* run off the Reel, while the Half-Minute-Glass runs out, will give you the Swiftness of the Current, or Number of Miles it runs *per* Hour; if you add about $\frac{1}{4}$, or *more* or *less*, for the *Drift* of the Boat with the Current, according to the *Depth, Weight*, or Capacity of the *Sinker* to keep the Boat *more* or *less* steady; which must be judged. And the Direction of the *Line* being set by the Compass, will shew you to *what Point* thereof the Current sets.

OR, the *leaded Board*, aforesaid, being hove into the Ship's Wake, as she sails, and suffered to *sink* below the Depth of the Current, the *Line* fastened thereto will shew you the *Current's Direction*. And if the Half-Minute Glass be turned, when sufficient Length of *Line* is veered out for sinking the *Board* below the Current, then, as many *Knots* as she more runs off, from a *Mark* in the loose-Line last come in Sight, while the Glass *runs out*, (measuring the *Plus-line* afterwards) so many *Miles* the *Current* and *Ship* together move in an *Hour*. With which Motion, if you compare the Ship's Motion, measured by the Log, upon the Top of the Current, you will have the Velocity of the Current, separately, as it is *with*, or *thwarts*, the Ship's Motion. But having the Direction and Velocity of *both*, the *other* Direction and Velocity is *not wanted*. This Way you may some Times lose your *Board* or *Sinker*, and Part of your *Line*.

The *Quantity* of a Current's Motion is determined by keeping the Reckoning of a Ship *outward* and *homeward* bound, as exact as possible; the *Difference* of which *two Reckonings* being the Current's Motion: supposing it constant.

In a furrowed Sea, a Current's Direction is a-cross the Ridges of the Waves raised by the Wind.

REMARK. *In several* Straits *there is a Current above, and another below. In the* Straits *of* Gibraltar *the* Atlantic *Ocean continually runs into the* Mediterranean, *while an under Current, from the* Mediterranean, *runs the contrary Way into the* Atlantic.

There is a Current in the Baltic Sound, 4 *or* 5 *Fathoms deep, and another under it.*

A Current from the Euxine Sea *sets through the Straits of* Constantinople *and* Propontis.

And in all other Straits, *where there are rapid* upper Currents, *it is probable there are likewise* under Currents *setting the contrary Way.*

PROPOSITION. If a *Ship* be considered at *Rest* in the Sea, while that Sea has a *Current* setting towards some one Point of the Compass, it is the same Thing in Effect of Computation, as if there was *no Current*, while the Ship sailed with the Current's Motion towards *that Point*.

HENCE, in correcting your Course steered by the Compass, you may consider your Ship, sailing upon any Course, as if she sailed upon a *new* or *altered Course*, the same as is that of the Current's Motion, instead of considering that Motion.

And, the *Distance* on your *Course, steered by the Compass*, is corrected by the Current's Motion in the *Ship's Direction* (computed from its Motion *per* Hour in the Angle with the Ship's Direction) by *adding* that Motion to the *Distance* sailed, or *subtracting* it therefrom, as it sets *towards, or contrary to, the Ship's Direction*.

Of MEASURING the SHIP's WAY.

Of the *Seaman's* COMPASS, LOG-LINE, LOG, HALF-MINUTE GLASS, and LOG-BOARD.

THE common *Mariner's Compaſs* is well known, and needs no Deſcription. But the *Mariner's Compaſs improved*, and recommended for its greateſt Advantage to Navigation (by its *Inventor*, Mr. *Emerſon*) is as follows.

The Needle is fixed to a *moveable plain Card*, under the *Compaſs Card*, which going ſtiff and being ſet, as a *Rectifier*, to the preſent *Variation*, in the *Compaſs-Card* above it, the *Fleur de Luce* of that *Card* will always point to the *true North* and *South* Points of the Horizon, and likewiſe each Point of this Compaſs to the *true Courſe* ſteered by the Ship. By which Means *frequent* Trouble and Miſtakes are prevented in correcting the ſeveral Courſes ſteered by the Compaſs, to the true Courſe.

The *Log-line*, *Log*, and *Half-Minute Glaſs*, are well known, by *Seamen*, for their great Utility in *ſteering* the Ship, and *meaſuring her Way* through the Ocean.

When the *Log* is heaved, as many *Knots* and *Tenths* of Line as runs off the *Reel*, while the Half-Minute Glaſs runs out, ſo many Miles and Tenths of a Mile the Ship runs in an Hour.

The *Half-Minute Glaſſes* may be proved by a Thread, and a leaden Ball at the End thereof, hung up $39\frac{2}{10}$ Inches long, from the Point of Suſpenſion of the *Thread*, to the Center of the *Ball*. Which Ball being put in Motion, will vibrate exactly in a *Second* of Time; and if the *Glaſs* runs out while 30 Swings or Vibrations are made, paſt the Perpendicular, then that Glaſs is true, otherwiſe not. Another Proof of Half-Minute Glaſſes, is by one already proved.

THE *Knots* of the *Log-line* are judged beſt to be 45 or 46 *Feet* aſunder, betwixt Knot and Knot; though 50 Feet aſunder agree neareſt with the 120th Part (the Number of Half-Minutes in an Hour) of the 60th Part of a Degree of a great Circle of the Earth, or a Mile, by which the Knot-Diviſions are computed. But the Log *dragging* ſomewhat after the Ship, meaſures her Diſtance this Way leſs than it is; and therefore, the *leſs* Diviſions of 45 or 56 *Feet*, between Knot and Knot, are found to agree beſt with Practice. Some Navigators, in our Time of uſing the Sea, divided their *Log line* by 42 *Feet* only between the Knots; which yet, by a due Correction of the *Dead-Reckoning*, by frequent Obſervations, have ſome Times very nearly agreed with making the Land, after a long Voyage. And, in the *Sea-Phraſe*, it is always *better for the Reckoning to be a-head of the Ship, than for the Ship to be a-head of the Reckoning.*

But with Reſpect to meaſuring a Ship's Diſtance by the Log, if her Reckoning was kept by *Degrees and Hundredth Parts*, inſtead of by *Degrees and Sixtieth Parts*, as at preſent, there would be no Trouble of Reduction (as Mr. *Emerſon* obſerves) of Degrees to Minutes, and of Minutes to Degrees. And the Knots of ſuch a *Log-line*, meaſuring Hundredths of a Degree in Half-Minutes, would be 27 *Feet* aſunder. In which Caſe of keeping a Ship's Reckoning, multiplying theſe *Cents* above *Degrees* by 6, the Product of the 1ſt Figure with what is carried from the 2d, would give the Miles above Degrees *mentally*. And cutting off 2 Figures to the Right, from any Number of *Cents*, would give the Degrees and *Cents* over, at once.

Some *Maſters* of Ships, and other experienced *Seamen*, eſtimate the Ship's Diſtance ſailed in an Hour, or other Interval, by throwing a *Chip* over Board, by the Motion of which along the Ship's Side they judge of the Diſtance. And a Ship's Way, in the Day-Time, may be nearly eſtimated by obſerving the Motion of the *Bubbles*, or *Sea-Foam*, paſſing by the Ship's Side from *Stem* to *Stern*.

But, for more *Exactneſs* and *Certainty*, in meaſuring the Ship's Way over the Ocean, the *Log* is generally *hove* every two Hours (and may be heaved every Hour if Navigators pleaſe) when the Diſtance, that Way meaſured, and Courſe ſteered by the Compaſs, are carefully *chalked* into the *Log-Board*, contrived with *Partitions* for that Purpoſe, as well as for entering all *Remarks* and *Occurrences*, that happen in 24 Hours. At the End of each of which *Intervals*, the Ship's Reckoning for the Day is made up: but not till after an Obſervation of the Sun, at *Noon*, is taken (if *poſſible*) by which the *Dead-Reckoning* (as it is called) is daily and duly corrected; or as often as an Obſervation of the Sun, at *Noon*, can be had.

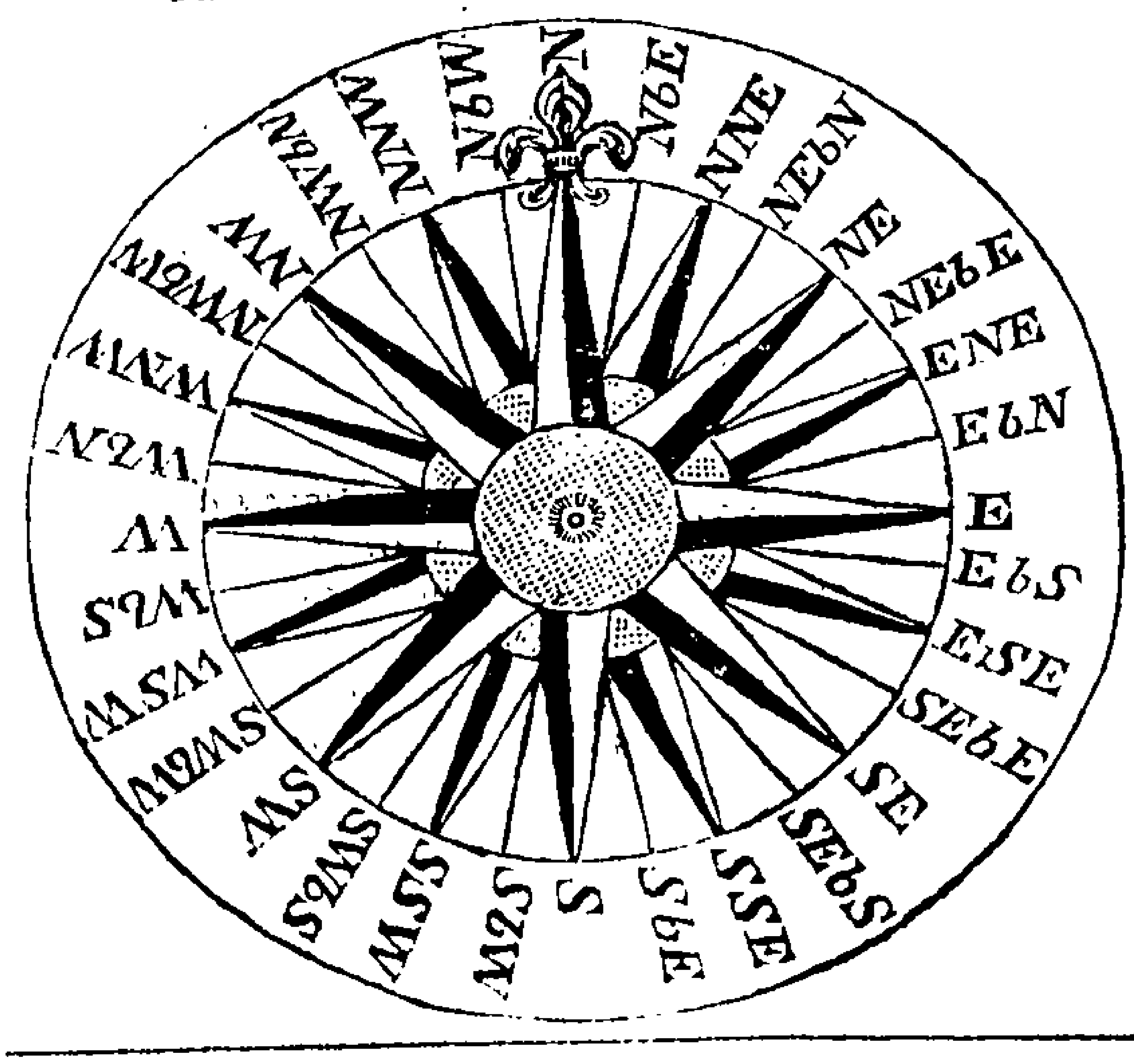
MAY the 15th, 1760.

The LOG-BOARD.

Hrs.	*Courses.*	*Knots*	*Winds.*	REMARKS and OCCURRENCES.
2	S. W.	6.5	N.W.*b*.N	*Variation* 2 Points. from S. to E. or N. to W. Left Hand.
4		7.6	NW.*b*.W	*Squally* with Rain.
6	S.S.E.	8.1	W.*b*.S.	*Hard Gales.*
8		7.0		Came up with the *Triton.*
10	N.W.½W	6.0	S.W.*b*.S.	Joined the *Centurion, Anson,* and *Defiance.*
12		6.7		
2		6.5	W.S.W.	*Lee-Way,* 2 Points. Took a *Reef* in our Topsails. [in Company.
4	S.W.*b*.S.	6.3	W.*b*.N.	2. The *Thunder* and *Lightning Bombs*
6		5.5		Saw a *Sail* to Windward. 2. A *Current* sets W.*b*.N. 4 Hours,
8	S.E.*b*.E.	6.1	N.W.*b*.N	0. at 2½ *Miles* an Hour.
10	S.W.*b*.W	5.1		0. *Got ready for engaging.* [*Nymph.*
12	S. W.	4.3	W. N. W.	1½ *Lee-W.* At Noon spoke with the *Sea-*

Former 24 Hours, *May* 14, at Noon.	*Latitude* / *Longitude*	40° 19′ N. / 21 35 W.	By Observation corrected.
Last 24 Hours, *May* 15, 1759, at Noon.	*Latitude* / *Longitude*	39° 2′ N. / 21 3 W.	By *Dead-Reckoning.*

The SEAMAN's COMPASS.



THE above Figure of the *Seaman's Compass* is usefully placed *here,* and at the *Bottom* of every *Log-board, hung up in a Ship's Steerage,* for the more certain rectifying the several Courses steered by the Compass, to the true Course; and likewise the *better* to allow for *Lee-Way,* as it happens to be the same Way with, or contrary to, the *magnetical Variation.*

And from the *repeated Trouble* of correcting the *magnetical* to the *true* Courses, for casting up a Day's Reckoning, as in the *Example above,* of the several Courses *rectified,* it is seen how much *Navigation* suffers in its Improvement, for Want of a *Mariner*'s Compass rectified, by the present *Variation,* so as for all its Points to correspond with the true *North* and *South* Points, and other Points of the *Horizon.*

And, in *Imitation* of so competent a Judge as Mr. *Emerson,* we would recommend this *useful Improvement* to the Attention of the most expert *Mathematical Instrument-Makers,* in *London.* And to all *Masters* and *Captains* of Ships for putting the same in Practice: especially by the Authority of the RIGHT HON. the LORDS of the ADMIRALTY.

On Board His Majesty's Ship, DREAD-NOUGHT.

A DAY's RECKONING.

Courses corrected.	*Pnts.*	*Dist.* Miles.	*Dif. Lat.* N.	*Dif. Lat.* S.	*Departure.* E.	*Departure.* W.	*Dif. Long.* E.	*Dif. Long.* W.
S. S. W.	2	14.1	. . .	13.03	. . .	5.39		14.09
S. E.	4	15.1	. . .	10.67	10.67	. . .	27.82	
W.N.W½W	6½	12.7	3.68	. . .	. . .	12.15		31.53
N.W.½W.	4½	6.5	4.36	. . .	. . .	4.81		12.50
S. *b*. E.	1	11.8	. . .	11.57	2.30	. . .	5.97	
Current W. *b*. S.	7	5.	. . .	0.97	. . .	4.90		12.68
E. *b*. S.	7	6.1	. . .	1.19	5.98	. . .	15.47	
S. S. W.	2	5.1	. . .	4.71	. . .	1.95		5.03
S. ½ W.	½	4.3	. . .	4.28	. . .	0.42		1.08
Course made good for 24 H. S. *b*. W. 4° 17′W. *Distance* 79′.67 Miles.			8.04 Dif.	46.42 38.38	18.95 Dif.	29.62 10.67	49.26 Dif.	76.91 27.65
Long. 28′ W. By *whole* Dep.	Doubled.		. . .	76.76	. . .	21.34	By *separate* Dep. and Dif. Lat.	
Middle Latitude 39° 41′			*Dif. Lat.*		*Departure.*		*Dif. Long.*	

THE above DIFFERENCES of LATITUDE and DEPARTURES for the several corrected *Courses* and *Distances* run on each *Course,* are taken out, with great *Ease* and *Readiness,* from the *Seaman's* COMPUTER, No. I. And being *summed* up in their respective Columns, the Difference of the *Northing* and *Southing,* and also *Easting* and *Westing,* will answer to Half of the *whole* (*because they are computed but for 12 Hours in 24, as set down in the Log*) which therefore being *doubled* will give the whole *Northing* or *Southing,* and whole *Easting* or *Westing,* as the EXAMPLE shews.

Then, *subducting* Half the Difference of Latitude 38′ from the Latitude 40° 19′ departed from the former Day, the *middle Latitude* 39° 41′ will remain.

And, As *Cos. mid. Lat.* : *Rad.* :: *Depart.* : *Dif. Long. very nearly* in *short Runs*; and differs but little from Truth in *long Runs,* as may be proved; notwithstanding the groundless Objection by the late *Author of the Spheroidal Navigation,* to this *useful* RULE, or APPROXIMATION.

Dif. Lat. Dep. Quote
BUT, 76,76)21.34(,2780, Against which, in COMPUTER No. II. under *Col.* 10000, in *Col.* Departure, stands 15° 32′ the *Course,* S. *westerly,* made good for 24 Hours.

	Com. mid. Lat.	*Depart.*	*Dist. for Dif. Lon.*	
Again By *Computer* No. II.	50° 19′ taken as the Course.	20′.	25′.83	The Dist. is also had thus, 79.6 by true Course.
		1.	1.29	
		·3	·39	
		21.3	27.51	Longitude required.

THUS, *all the Differences of Longitude to the separate Courses, in a Day's Reckoning, may be found for each middle Latitude and Departure first found, according to the two last Columns;* which you see is a Refinement *of no Advantage, but a great Deal of Trouble to shew that the* correctest Navigation, *by limited and separate Departures, for several distinct Courses in a Day's Run, agree with the Longitude taken from the Collection or Difference of all these Departures in a Day, according to the short and usual Way of finding the Longitude for a Day's Reckoning.*

The *expert Navigator* may shorten Trouble, and save his Attention to the *Tables,* if he is ready at using the GUNTER's SCALE OF PROPORTION, by Means of extending the COMPASSES thereon, *in the Use of three Terms to find a fourth.* And here it will be As *Cosine middle Lat.* : *Sine Course* :: *Dist. run* : *Diff. Long.*

But herein we refer the *Navigator* to Mr. EMERSON's *Navigation,* for ample Satisfaction; who has excelled all the Writers on the Subject, for *Variety, Brevity,* and *Practice*; to whose Navigation this *Part* of our WORK is (as we said before) *supplemental.*

N. B.

Of correcting a SHIP's DAILY RECKONING.

N. B. The Mean of the Knots set down every two Hours in the Log, being taken for the intermediate Hours, is a *Refinement* of *no Use in Practice*: since if it were, the Log might be heaved every Hour. And till a *Method* can be found of measuring the Distance and of steering the Ship's Course, with less *Doubt* and *Error*, heaving the Log every 2 Hours is sufficient. For, if a Ship's Way through the Water could be measured with more *Exactness*, yet as there will always be *Uncertainty in the Course* made good, especially in *high Seas, cross Winds, strong Tides, Currents, &c.* one general *Method* for correcting all Ship's Reckonings, *(except by observing the Longitude)* must suffice as follows.

RULES for CORRECTING a SHIP's RECKONING.

A Ship's Reckoning is corrected by an Observation of the *Sun*, at *Noon*, as often as it can be taken; by which, finding your Latitude by Observation, you discover the *Truth* or *Error* of your Latitude by *Dead-Reckoning*. If these two agree, then your *Departure* or *Longitude* are supposed to be right, and require no Correction. But when they differ, you proportion the *Correction* of Departure and Longitude, by the Error of Latitude, found in your Reckoning.

FIRST, you may examine if you have rightly allowed for *Variation* and *Lee Way*, and made due Correction of your *Courses*, and especially by allowing for *Currents*, and if after rectifying any Mistakes you have committed, and again going over the *Operations*, your Latitude by Reckoning and Observation will not agree, you may suspect a *Current* to be the Cause of the Difference; as not knowing its Quantity of *Motion*. But, if you know its *Direction*, or Course, use the following

RULE I. For CORRECTION of DEPARTURE. ——— As *Radius* : *to Tan. Angle of the Current's Direction with the Meridian* :: *so Error in Latitude* : *to Correction in Departure.*

If the *Latitudes* will not yet agree, and your Course sailed be *nearer* the Meridian than to the *East* or *West*, the *Error* is likely to be in the *Distance*. Here find the Difference of the *Latitude* and *Departure* since the last Observation, and say by

RULE II. For CORRECTION of DEPARTURE. ——— As *Diff. Lat*: : *to Error in Latitude* :: *so Departure* : *to Correction in Departure.* To be added or subtracted, according as the Ship is before or behind the Reckoning.

But if your *Course* is nearer to the East or West Points than the Meridian, the *Error* is likely to be in the *Course*. Here take the Difference of *Latitude* and *Departure* since the last Observation, and say by

RULE III. For CORRECTION of DEPARTURE. ——— As *Departure* : *to Error in Latitude* :: *so Difference of Latitude* : *to Correction in* DEPARTURE.

☞ If the *Course*, in this *Case*, be very near the *East* or *West*, this Correction then, so very small, will be *needless*.

WHEN you steer about the *Middle-Way*, betwixt the *East*, or *West*, and the *Meridian*, you may correct either *Course* or *Distance*, wherein you conceive the Error mostly lies: but, if you are not convinced of one being more erroneous than the other, you may divide the *Error* betwixt both and so correct each.

RULE IV. For CORRECTION of the LONGITUDE. ——— As *Error in Latitude* : *to meridional Difference of Latitude between the computed and observed Latitude* :: *so Correction in Departure* : *to Correction in Longitude.* To be *added* or *subtracted*, according as the *Ship is a-head* of the Reckoning, or *Reckoning a-head* of the Ship.

ANOTHER RULE. To know if the ERROR of the *Ship's Reckoning* be in the COURSE or DISTANCE?

In sailing betwixt the Meridian and E. or W. } If the { *Dif. Latitude* / *Departure* } be the *greater*, the Error is probably in the { *Distance* / *Course*

N. B. When the Difference of Latitude is greater than the Departure, and the Error of *Reckoning* be in the *Distance*, it may be thus *corrected*.

As *Dif. Lat. by Reckoning* : *true Dif. of Lat.* :: *Departure by Reckoning* : *to true Departure*
(By similar △s included in one another) :: *Distance by Reckoning* : *to true Distance.*

Then, As *Corrected Dif. Lat.* : *corrected Departure* :: *Radius* : *Tangent true Course.*

☞ When the *Ship* has out-run the *Reckoning*, it is too little, and you must *add* the *Difference*; but the *Reckoning* having out-run the *Ship*, it is too much, and you must *subtract* the Difference.

CASE

CASE I.

Lat.	*Ship's Mot.*	*Lat.*	*Ship's Mot.*					
N.	towards N.	S.	towards S.	If the observed Lat. be	*greater*	than Lat. by Reckoning.	*Ship* out run the *Reckoning.*	+
					less		*Reckoning* out-run the *Ship.*	—

CASE II.

Lat.	*Ship's Mot.*	*Lat.*	*Ship's Mot.*					
N.	towards S.	S.	towards N.	If the observed Lat. be	*greater*	than Lat. by Reckoning.	*Reckoning* out-run the *Ship.*	—
					less		*Ship* out-run the *Reckoning.*	+

IF the *Error* in the Diſtance proceed from the *Log*, or the incorrect Way of meaſuring it, as in general the Ship's *Diſtance* is *greater* than is meaſured, then you may take 1 Mile in 10 ~~leſs~~, if a great Sea follows the Ship; but leſs, when a leſs Sea follows. And when the Sea's Motion is *contrary* to or *athwart* the Ship's Motion, her *Way* is *leſs* than the Diſtance meaſured by the *Log*. And the Time of Tides and their Setting will alter the true Meaſure of the Ship's Way, which muſt be obſerved.

REMARK on the *foregoing* METHODS of CORRECTING a SHIP's RECKONING.

ALL *the* METHODS *of Correction here given, are but precarious, while there are no other to depend on: Except what we have ſhewn by obſerving the Longitude, as near as is practicable.*

The *Agreement* of ſeveral Ships' Reckonings, proceeding together in the ſame Voyage, is an Argument of their Truth; as their *Difference* may ſerve to correct one another.

The *Reckoning* (in Longitude and Latitude) of a Ship you meet at Sea, will ſometimes be of Uſe to correct your own.

Here you ſuppoſe an Error in the *Courſe* or *Diſtance* only, while it may be in both. But if one Error ballances the other, ſo as to give the computed Latitude near that by Obſervation, then no Error in either *Courſe* or *Diſtance* will appear; and yet an Error may be in the *Longitude*, though you are not able to diſtinguiſh it. And if the *Error* in both *Courſe* and *Diſtance* lie one *Way*, ſo as to make great Difference in the Latitude, there may be but *little* Error in Longitude; which yet muſt be corrected in *Proportion to the Error of Latitude*, by the *preceding Rules*.

REMARKS on B. MARTIN's NEW NAVIGATION, in a *Second* LETTER from a *Correſpondent*, dated *June* the 16th, 1759.

TO the AUTHOR of the ROYAL ASTRONOMER and NAVIGATOR.

SIR,

I perceive, by the Sheets you ſent me, that you have taken more Pains with *B. Martin*'s Book than I think was worth the Time beſtowed; for I am perſuaded that *Nobody will ever follow his Steps (or Method) by Sea, whatever they do by Land.*

Could one meaſure the *Sea* as *exactly* as a Man can meaſure the *Land*, and could he take the *Angle* of the *Courſe* as near as one can take an *Angle* on the Ground, with an Inſtrument, this *Refinement*, of ſpheroidal Navigation, might be of ſome Conſequence. But ſince neither the *Courſe* nor *Diſtance* can be truly known to a 20th Part, and often more, it muſt be a very idle Thing to introduce *difficult* Calculations to correct an *Error*, which is no Way ſenſible when found out. For what ſuch a *trifling Error* as this amounts to, in a Day's Run, is ſwallowed up in the other *grand Errors*, which are unavoidable. And this Error, as well as thoſe greater ones, are all corrected as ſoon as an Obſervation can be made.

The only *Queſtion* that remains to be anſwered is, Whether this *trifling* and *inſignificant Error* is worth all that *laborious* Calculation beſtowed on it by *B. M.* in his *Folio Book?* I think *not*; and if *he*, or *Murdoch*, thinks *otherwiſe*, I have Nothing to do with *that*, or they with me. And alſo (which is an unanſwerable Argument againſt it) he cannot tell what *Species* of a Spheroid the Earth is; the Parts of this Book are ſo contradicting, as to make the *Excentricity* in one Page more than double that in another; which is therefore a *hopeful Theory* for a NAVIGATOR to depend on.

But is not the Motive of introducing *(or rather lugging in)* this Theory by the Head and Shoulders, *Vanity* more than Uſe, that the Proprietor might not *miſs* the Opportunity of letting the *Right Honourable the L--ds of the A--------y* know how well he is acquainted with the *Figure of the Earth?* Who ſeems ſo fond of the Invention, and it ſo tickles his Fancy, that he would apply it to *every Thing, whether it ſuits or not.*

But, when he has contrived his *Compaſs*, which is to be 100 Times more exact than the common Sort, and his *New Nautical Dreameters*, by which he can get the *Courſe to a Minute*, and *the Diſtance to the utmoſt Exactneſs*, it will be Time enough then to take in the *minuter Inequalities*, ſuch as proceed from the *ſpheroidal* Figure of the Earth; and get an *Inch or two* more that Way. So that it is to be hoped, from all theſe Improvements, there will be no need, afterwards, to correct either the *Latitude* or *Longitude*.

I ſhall only further take Notice, that, in the *Preface to his Second Part*, he ſays "he has added the *Mechanic Principles of Navigation*, as he "has not ſeen them in any other Treatiſe of this Kind," which is *a little ambiguous*; for he has, or might have, ſeen them in EMERSON's NAVIGATION; except he was reſolved to ſee Nothing but what he did not like. But he is ſuch a *modeſt Proprietor* of original *Invention* and *Improvement*, that he is not aſhamed of *any Thing* he ſays, nor from *whence he borrows his ſelect Materials.*

NEWTONIENSIS.

DIMENSIONS

DIMENSIONS and WEIGHT of SHOT.

TO determine the Weight of an Iron-Ball from its Diameter being given, and the Diameter from the Weight?

FIRST, As 3.1416 : to 1 :: ſo is the Meaſure round any Ball : to its Diameter.
NOW, As 100 : to the Cube of an Iron Ball's Diameter in Inches :: ſo is 14 to the Weight of that Ball in Pounds.

EXAMPLE. *If a Ball meaſures 14 Inches round, required its Weight?*

3.1416)14.0000(4.456 Inches,
Cubed = 88.478
Multiplied by 14 = 1238.692 lb. oz.
Divided by 100 = 12.387 = 12 6,192 Wt. [reqd.

If the Weight of a Ball be 42 Pounds, required its Diameter?

42 by 100 = 4200
Divided by 14 = 300 Its Log. = 2.4771213
3.1416 × 6.6948 = 20.177 Inches round the Ball. One Third = .8257071 Its No. 6.6948 Inches Diam. required.

☞ *The Method of directing a Ship through* Sands, *into a* Harbour, or River's Mouth, *by Sea and Land Marks, (ſuch as* Buoys, Light Houſes, Steeples, Windmills, *or other* remarkable *Objects, contrived or fixed on Purpoſe) is known to every experienced Navigator. But thoſe who deſire Satisfaction herein may conſult* Mr. EMERSON's NAVIGATION, *P.* 62 *and* 63. See alſo his *Mechanics* (comprehending all other Books on the Subject) *for computing the Force of a* Ship's Tackle, which he has partly exemplified *in his* Navigation, *p.* 63. *making the Force of the Hand to the Weight as* 1 *to* 4 in a particular *Inſtance. To which* diſtinguiſhed AUTHOR, *and his* WORKS, *we have ſometimes been beholden for Judgment and Improvement in our Subject: Who compriſes all his* Subjects of Science, *in the* feweſt *Words and* ſhorteſt *Method.*

*** THOSE who chuſe to ſail as near as they can by the *Arch of a great Circle*, or to uſe *Great-Circle-Sailing*, as preferable to *ſpheroidal Sailing*, (ſuppoſe from the *Capes* of *Virginia* to the *Cape of Good Hope*, or from the *Cape of Good Hope* to *Cape Horn)* may compute the Angles of Poſition, Length of the Arch betwixt two Places, and Latitudes of the Arch, to every 5 or 10 Degrees of Longitude, by Spheric Trigonometry; and then the Courſe and Diſtance, from one Latitude to the other on that Arch, by *Mercator Sailing*; placing the ſeveral conſtant *Courſes* and *Diſtances* thereon, in a *Table* for putting in Practice, *as near as poſſible. For the Anſwers to all the Caſes of right and oblique angled ſpherical Triangles, ſee further on; being the Principles and Grounds of* Practical Aſtronomy *in the foregoing Part of this Work. To which Caſes are added numerous Affections and Properties of Triangles, in general.*

PLACE of TURNING to WINDWARD, and Diſtance of *Head*-LAND.

TO compute the PLACE *of a Ship's Turning to Windward ſo as to reach her intended* Port, *or* Object, *by once Tacking?*

WHEN a Ship or Veſſel is cloſe *hauled*, ſhe lies within about $5\frac{1}{2}$ Points of the Wind, or 61° 52′, on either Side of it.

LET D be the *Diſtance* of the *Port*, or *Object*, at the Place ſailed from;
A° the ∠ of the *Courſe* ſailed, with the *Port* or *Object*, on the ſame Side of the Wind;
Then, 61° 52′ — A° = ∠ of the *Wind* and *Port*, at the Place ſailed from, on the *ſame Side of the Wind with the Courſe*;

And $2 \times \overline{61^\circ 52' - A^\circ}$ = ∠ of the *Courſe* and *Port* on the contrary Tack, or Side of the Wind = ∠ at the *Port* or *Object*, between the Place ſailed from, and *that* of turning to Windward, or Tacking;
Alſo, $180^\circ - \overline{2 \times 61^\circ 52'} = 56^\circ\ 16'$ = ∠ between the Place *ſailed from* and intended *Port*, at the Place of Tacking.

Therefore, As Sine 56° 16′ : to D, the Diſtance of the Port from the Place of Departure, :: ſo Sine 123° 44′ — A° : to Diſtance between Place *ſailed from*, and that of *Tacking*, or Turning to Windward, *required*.

☞ *The Place of Turning to Windward in a Current may be likewiſe determined* trigonometrically.

To compute the Diſtance of a HEAD-LAND, *or* CAPE, *at* SEA?

SET the Angle of the *Head Land*, and your *Ship's Way*, by the *Compaſs*, and after Sailing for ſome Time on that Courſe, ſet the Angle of the *Head Land* and your Ship's Way a *ſecond* Time: Then, Say by PROPORTION, from the Tables of natural *Sines*, or by *Logarithms*.

As *the Sine of the Remainder after the Sum of thoſe Angles is taken from* 180 *Degrees : to Diſtance run between taking the* firſt *and* ſecond *Angle, :: ſo is Sine of either Angle taken : to the Ship's Diſtance from the* Head-Land, *when the other Angle, with the Ship's Way, was taken.*

☞ The Connexion in this Page, and another or two, is as the Copy could come in.

TO *measure the* TONNAGE, *or* BURTHEN *of a* SHIP.

THE Rules laid down, by several Authors, are as follow.

RULE I. Divide the Product of her Breadth, half Breadth, and Length, in Feet, by 94, and the Quotient will give the Tuns of her Burthen.

RULE II. Divide the Product of her Length, Breadth, and Depth, in Feet, by 100 for Ships of War, or 95 for Merchant-Men, that allow Nothing for Guns, and the Quotient will give the Burthen in Tuns.

RULE III. Subtract two Thirds of her Breadth from her Length (measured from the Stern-Post to the upper Part of her Stem) and the Product of that Remainder, the Breadth, and Half-Breadth, in Feet, being divided by 100, or 94, will give the *King*'s, or *Merchant*'s Tonnage, respectively.

RULE IV. A Ship's Tonnage, or Burthen, is equal to Half the Weight of Water she will hold.

N. B. *There is such a Variety in the Forms of Ships, that no one Rule can measure their Burthens exactly; but the above Rules are the most general in Practice.*

POSITION of the SAILS and RUDDER, in Working a SHIP.

Observation 1. *Placing the Sails according to different Positions in Respect of the* Wind *and* Ship's Way, *have* more *or* less *Force to draw the Ship along, or turn her about.*

2. *The Head-sails keep the Ship steady and serve to make her ware.*

3. *Main-sails move the Center of Gravity of the Ship.*

4. *Mizen-sails serve to keep her from* sheering *backward and forward, and to force her* Stern *to* Leeward.

5. *Sails have more or less Force the torter or slacker they are hoisted: a bagging Sail drawing less than one that is well hoisted.*

6. *The higher a Sail is hoisted the more Wind it receives to draw the Ship along, or turn her about.*

7. *When a Ship goes directly before the Wind, any one Sail placed at right Angles with her Way draws with the greatest Force. But since one Sail hinders the Wind from acting against another, being all placed in that Position, if they all receive the Wind at an Angle of about* 60 *Degrees they will draw together with the greatest Force.*

8. *Wet Sails draw more than dry Ones.*

9. *The* nearer *to, or* further *from, a right Angle any Ship's Sail is placed with the Way of her Course, the* less *or* more *Lee-Way she makes.*

10. *The nearer the Wind is with, or further from, the* Ship's Way, *the* less *or* more *Lee-Way she makes.*

11. *By the* Principles of Mechanics, *the Angle between the* Wind *and* Ship's Sail *must be about* twice *as much as the Angle between the Sail and the* Ship's Way, *to sail* near *the Wind with the greatest Motion.*

12. *If the* Wind *is almost upon the* Beam, *the Angle between the Wind and the Sail must be about* once and half *the Angle between the Sail and Ship's Way.*

13. *If a* Ship *sails almost before the Wind, the Angle between the Wind and Ship's Sail should be about equal to the Angle between the Sail and her Way. All these Positions of the Sails are necessary to give the Ship the* greatest Motion possible.

14. *The nearest a Ship can lie to the Wind being about* $5\frac{1}{2}$ *Points or* 60 *Degrees, the Angle between the* Wind *and* Sail *should be about* 38°, *and the Angle between the* Sail *and the* Ship's Way *(or* Keel*)* 22°, *or* nearly *in that* Ratio, *to make her go fastest to* Windward.

15. *If the Wind is nearly upon the* Beam, *the sharper the Head-sails are set they have the more Power to turn the Ship's Head about.*

16. *If the Wind's Way be nearly the same as the Ship's Way, the Sail ought to make an Angle with the Ship's Way of* 54°, *to turn her soonest about.*

17. *The most powerful Position of the Rudder to turn the Ship about has been computed, from Principles of Mechanics and Fluxions, at an Angle with the* Keel *of* $54\frac{1}{4}$ *Degrees.*

18. *The faster a Ship sails the better she answers her Helm.*

19. *If she sails slow she will scarcely steer. And the more she heels the less she answers her Helm.*

See Mr. *Emerson*'s Navigation, for further Satisfaction.

The

The PROPERTIES of MAGNETIC VARIATION.

Property 1. Variation in *Quality* is either E. or W. Variation of the *magnetic* from the *true* North Point.

2. Variation in *Quantity* is the Number of Degrees (E. or W.) of the *magnetic* from the *true* North Point.

3. $\left.\begin{array}{l}\text{When}\\ \text{Then}\end{array}\right\}$ the *magnetic* $\left\{\begin{array}{l}\text{N.}\\ \text{S.}\end{array}\right\}$ varies fr. the *true* $\left\{\begin{array}{l}\text{N.}\\ \text{S.}\end{array}\right\}$ towards the $\left\{\begin{array}{l}\text{E.}\\ \text{W.}\end{array}\right.$ Both to the *Right* of the same *tr. Point.*

4. $\left.\begin{array}{l}\text{When}\\ \text{Then}\end{array}\right\}$ the *magnetic* $\left\{\begin{array}{l}\text{N.}\\ \text{S.}\end{array}\right\}$ varies fr. the *true* $\left\{\begin{array}{l}\text{N.}\\ \text{S.}\end{array}\right\}$ towards the $\left\{\begin{array}{l}\text{W.}\\ \text{E.}\end{array}\right.$ Both to the *Left* of the same *true Point.*

5. All the *magnetic Points* are carried as far as to the $\left\{\begin{array}{l}\textit{Right}\\ \textit{Left}\end{array}\right\}$ of the same *true Point* as is the $\left\{\begin{array}{l}\text{E.}\\ \text{W.}\end{array}\right\}$ Variation.
Therefore,

6. The true *Point*, *Azimuth*, or *Amplitude*, (to which the corresponding *magnetic Point* is always directed) being reckoned on the same *magnetic Compass* from N. or S. to the E. or W. lies the same Way with the Variation, to the $\left.\begin{array}{l}\textit{Right}\\ \textit{Left}\end{array}\right\}$ of the *magnetic Point*, *Azimuth*, or *Amplitude*, as much as the *Variation* lies to the $\left\{\begin{array}{l}\textit{Right}\\ \textit{Left}\end{array}\right\}$ or $\left\{\begin{array}{l}\text{E.}\\ \text{W.}\end{array}\right.$ of the tr. N.

These Properties are evident by a RECTIFIER, or a *moveable* Compass on a *fixed one.* Hence the following

RULES *for determining the Quality and Quantity of magnetic* VARIATION.

Rule 1. The *Situation* of the true Azim. or Amplitude (reckoned on the same *magnetic Compass*) being to the $\left\{\begin{array}{l}\textit{Right}\\ \textit{Left}\end{array}\right\}$ of the magnetic *Azim.* or *Amp.* shews $\left\{\begin{array}{l}\text{E.}\\ \text{W.}\end{array}\right\}$ Variation.

2. The *Distance*, or Difference between the *true* and *magnetic* Azimuth or Amplitude is the *Quantity* of Variation, *i. e.* The *true* and *magnetic* Amplitude $\left\{\begin{array}{l}\text{both N. or S.}\\ \text{one N. other S.}\end{array}\right\}$ their $\left\{\begin{array}{l}\textit{Dif.}\\ \textit{Sum}\end{array}\right\}$ in Degrees is the Quantity of Variation.
Or, *if you always reckon the true and magnetic Amplitudes from their respective North Points, and then count them on the same magnetic Compass,*

3. At *Sun-Rising* $\left.\begin{array}{l}\text{True}\\ \text{Magnetic}\end{array}\right\}$ Amplitude being the *greater*, the Var. is $\left\{\begin{array}{l}\text{E.}\\ \text{W.}\end{array}\right\}$ But $\left\{\begin{array}{l}\text{W.}\\ \text{E.}\end{array}\right\}$ At *Sun-Setting.*
Or, *if you always reckon the true and magnetic Azimuths from their respective* N. *Points, and then count them on the same magnetic Compass,*

4. In the *Forenoon* $\left.\begin{array}{l}\text{True}\\ \text{Magnetic}\end{array}\right\}$ Azimuth being the greater, the Var. is $\left\{\begin{array}{l}\text{E.}\\ \text{W.}\end{array}\right\}$ But $\left\{\begin{array}{l}\text{W.}\\ \text{E.}\end{array}\right\}$ In the *Afternoon.*
N. B. *The first Rule is general, and answers* all Cases *that can be proposed.*

	Mag. Amp.	True Amp.	
Example 1. At Sun-Rising	15° E. N.	29° E. N.	*True* to the *Left* of *magnetic* Amplitude.
By second Rule	Dif. 14° . .		Variation W. by 1st *Rule.*
	Or 75° N. E. . .	61° N. E.	Magn. Amp. greater, theref. Dif. 14° W. Variat. by 3. *Rule.*
Example 2. At Sun-Setting	8° W. S.	14° W. N.	*True* to the *Right* of magnetic Amplitude.
By second Rule	Sum 22° . .		Variation E. by 1st Rule.
	Or, 98° N. E. . .	76° . .	Magn. Ampl. *greater*, theref. Dif. 22° E. Var. by 3. *Rule.*
	Mag. Azim.	**Tr. Azim.**	
Example 3. In the *Forenoon.*	10° E. S.	11° E. N.	True to the *Left* of magnetic Azimuth.
By second Rule	Sum 21° . .		Variation W. by 1st *Rule.*
	Or, 100° N. E. . .	79° N. E.	Mag. Azim. *greater*, theref. Dif. 21° W. Var. by 4. *Rule.*
Example 4. In the *Afternoon.*	30°40′W.S.	26°14′W.S.	*True* to the *Right* of the magnetic Azimuth.
By second Rule	Dif. 4 26 . .		Variation E. by 1st *Rule.*
	Or, 120° 40′ N. W.	116°14′ N. W. . .	*Magnetic* Azimuth *greater*, therefore Dif. 4° 26′ E. [Variation, by 4. *Rule.*

PRACTICAL RULES for finding the LATITUDE of the PLACE of OBSERVATION.

The Meridian ALTITUDE *and* Declination *of the* SUN or STAR, *given.*

CASE I. *Where the Object* (SUN or STAR) *rises and sets in a diurnal Revolution.*

Rule 1. The *Difference.* *Meridian Altitude and Declination both* N. *or both* S.

Zenith-Distance, Declination } The Latitude { *same* / *contrary* } Name of Declination { greater / less } than the Zenith Distance.

Rule 2. The *Sum.* *Meridian Altitude and Declination one* N. *the other* S.

Zenith-Distance, Declination } The Latitude { *same* Name of Declination.

N. B. *Meridian* Altitude, *or Zenith-Distance* S. *or* N. *means to the* S. *or* N. *of the Observer.* And Zenith-Distance is *the Complement of the* Meridian *Altitude.*

Example 1. *On the 16th of* May, 1760, *at Sea.*

To Sun's Zenith Distance	26° 44′ S.
Add Sun's Declination	19 16 N.
Sum (by *Rule* 2) the Lat. of Place of Observ.	46 0 N.

Example 2. *On the 12th of* June, 1761, *at Sea.*

From Sun's Declination	23° 12′ N.
Subtract Sun's Zenith Distance	8 35 N.
Diff. (by *Rule* 1) Lat. of the Place . . .	14 37 N.

Example 3. *On the 28th of* December, 1763, *at Sea.*

From Declination of *Syrius*	16° 23′ S.
Subtract Zenith Distance of ✱	10 9 S.
Diff. (by *Rule* 1) Lat. of the Place . . .	6 14 S.

Example 4. *On the 31st of August*, 1764, *at Sea.*

To Zenith Distance of *Fomalhaut*, or *brightest* of the Southern *Fishes*	11° 19′ N.
Add Star's Declination	31 1 S.
Sum (by *Rule* 2) Lat. of the Place . . .	42 20 S.

CASE II. *Where the* OBJECT (SUN or STAR) *neither rises or sets in a diurnal Revolution; but comes to the* MERIDIAN, *above the Horizon, on the contrary Sides of the elevated Pole, twice in* 24 *Hours.*

Rule 3. The *Sum.* *The* SUN *or* STAR *on the Meridian below the* POLE.

Meridian Altitude, Comp. of Declinat. } The Latitude { of the same Name with the Declination.

Rule 4. The *Difference.* *The* STAR *on the Meridian above the* POLE.

Meridian Altitude, Comp. of Declinat. } The Latitude { of the same Name with the Declination.

Example 1. *On the 12th of* June, 1764, *near* Spitsbergen, Greenland.

To Sun's meridian Altitude below the Pole . .	13° 9′ N.
Add Complement of Sun's Declination . .	66 47 N.
Sum (by *Rule* 3) the Place's Latitude . .	79 56 N.

Example 2. *On the 10th of* July, 1761, *at Sea.*

To Sun's meridian Altitude below the Pole . .	6° 12′ N.
Add Comp. of Sun's Declination . . .	64 47 N.
Sum (by *Rule* 3) the Place's Latitude . .	70 59 N.

Example 3. *On the 2d of* October, 1762, *at Sea.*

From the merid. Altitude of Northern Pointer of the *great Bear*, above the Pole . .	70° 14′ N.
Subtract the Comp. of the Star's Declination	26 51 N.
Diff. (by *Rule* 4) the Place's Latitude . .	43 23 N.

Example 4. *On the 23d of* March, 1763, *at Sea.*

To meridian Altitude of the *Foot of the Crosiers*, below the *Pole*	10° 28′ S.
Add Comp. of Star's Declination . . .	28 13 S.
Sum (by *Rule* 3) Place's Latitude	38 41 S.

See other Rules, in practical Astronomy, P. 190, 191.

REMARKS on II. CASE.

1. WHEN *the Sun comes to the Meridian below, and a Star comes to the Meridian of the same Place, both* above *and* below *the same Pole, twice in* 24 *Hours, the Latitude of that Place is of the* same Name *with the* Declination *of the* Sun *or* Star. *And the Declination of the* Sun *or* Star, *in such a Circumstance must be* equal to, *or* greater *than the Complement of the Pole's Height. And therefore, as the Sun's greatest Declination is* 23° 28′ ½, *its Complement is* 66° 31′ ½, *which is the least Latitude of the same Name with the Sun's Declination, where the* Sun *can come to the Meridian, above the Horizon and Below the same Poles twice in* 24 *Hours. And the least Latitude where a Star can come to the Meridian above the Horizon, and* above and below *the same Poles, twice in* 24 *Hours, is therefore the* Complement *of the Star's Declination of the same Name with the elevated Pole.*

2. *The Sun, or a Star, coming to the Meridian* below *the Pole, betwixt it and the Horizon, is then at its least Meridian Altitude, and coming to the Meridian on the contrary Side of the Pole, is then at its greatest.*

3. *Some Stars* (whose Comp. of Declin. of the same Name with the elevated Pole, is less than the Comp. of the Lat.) *come to the Meridian below the Pole, betwixt it and the Horizon, and above it, betwixt the* Pole *and* Zenith (where the Sun never comes) *at their greatest meridian Altitudes.*

4. *Every Star coming to the Meridian* below *and* above *the Pole, at its least and greatest Meridian Altitudes, respectively, is always to the Northward where the North Pole is elevated, or always to the Southward, where the South Pole is elevated.*

5. *Some Stars* (whose Complement of Declination, of the same Name with the elevated Pole, is greater than the Complement of Latitude) *come to the Meridian* below *the Pole and on the* contrary *Side thereof, beyond the Zenith betwixt the Pole and the Equinoctial,* (where the Sun comes) *at their greatest Meridian Altitudes.*

6. For those Stars coming to the Meridian betwixt the *Zenith* and *Equinoctial* (coming also under the Pole, but never between the Pole and Zenith) the 1st and 2d *Rules* (in Case 1) serve to find the Place's Latitude.

Geographica

Geographical RULES for finding the *tabular Difference* of LONGITUDE.

To find the DIFFERENCE *of* LONGITUDE *of two Places, according to the* old Way *of reckoning* E. Longitude, *from the Island of* Ferro, *round the* Globe.

	Bound fr. less to greater Long.					
Rule I.	Sub. less from greater	Remainder	less / more	than 180°	Difference of Longitude . . . / Take from 360° rem. Dif. Long.	E. / W.
	Bound fr. greater to less Long.					
II.	Sub. less from greater	Remainder	less / more	than 180°	Difference of Longitude . . / Take from 360° rem. Dif. Long.	W. / E.

To find the DIFFERENCE *of* LONGITUDE *of* two Places *according to the* new Way *of Reckoning E. or W. Longitude from the* Observatory *or* Metropolis *of any* Nation.

	Both E. Longitude						
III.	Sub. less from greater	Remainder	Dif. Longitude	E. / W.	bound to	greater / less	Longitude
	Both W. Longitude						
IV.	Sub. less from greater	Remainder	Dif. Longitude	W. / E.	bound to	greater / less	Longitude
	One E. other W. Long.						
V.	Sum of both	less / more	than 180°	Difference of Longitude / Take from 360° rem. Dif. Long.	same / contrary	Name of Long. failed to.	

N. B. Mr. Atkinson, *an Author in* Vogue, *has given Rules to find the Diff. of Lat. N. or S. from Latitudes given, both N. or S. or one* N. *and the other S. Also to find the other Lat. N. or S. from one Lat. N. or S. and Dif. of Lat. N. or S. given. But* Reason *finds these, with the* least Attention. *Whereas there is Trouble to the Attention, when the Mind is engaged, to find by the Table which Way the Longitudes lie, when wanted, without the above easy Rules, to prevent Mistake.*

EXAMPLES of finding the Difference of Longitude by the OLD WAY of Reckoning the LONGITUDES E. from *FERRO.*

		Longitudes	
Exam. I.	From *Havanna*	294°	40′
	To *Jamaica*	300	6
Rule 1.	Diff. Longitude	5	26 E.
Exam. II.	From *London*	18	10
	To *Martinico*	319	45
		301	35
		360	00
Rule 1.	Diff. Longitude	58	25 W.

		Longitudes	
Exam. III.	From *Cape of good Hope*	35°	35′
	To *London* . . .	18	10
Rule 2.	Dif. Longitude . . .	17	25 W.
Exam. IV.	From *Cape Horn* . .	298°	15′
	To *Cape of good Hope*	35	35
		262	40
		360	00
Rule 2.	Diff. Longitude	97	20 E.

		Longitudes	
Exam. V.	From *Jamaica*	300°	6′
	To *Barbadoes*	3 0	7
Rule 1.	Diff. Longitude	20	1 E.
Exam. VI.	From *London*	18	10
	To *Lizard* .	12	56
Rule 2.	Dif. Longitude .	5	14 W.
Exam. VII.	From *Constantinople*	47	30
	To *Gibraltar*	12	27
Rule 2.	Dif. Long. . .	35	3 W.

The above Answers are according to Mr. Emerson's *Navigation, and Tables of* E. Longitudes *reckoned from* Ferro.

EXAMPLES of finding the Dif. of Long. by the NEW WAY of Reckoning the LONGITUDES E. or W. from *Greenwich* Observatory.

		Longitudes	
Exam. I.	From *Havanna*	83°	0′ W.
	To *Jamaica*	76	37 W.
Rule 4.	Dif. Long.	6	23 E.
Exam. II.	From *London*	0	5 W.
	To *Martinico*	60	59 W.
Rule 4.	Dif. Longitude	60	54 W.

		Longitudes	
Exam. III.	From *Cape* of *Good Hope*	19°	30′ E.
	To *London*	0	5 W.
Rule 5.	Dif. Longitude . . .	19	35 W.
Exam. IV.	From *Cape Horn* . .	80	0 W.
	To *Cape of Good Hope* .	19	30 E.
Rule 5.	Dif. Longitude . . .	99	30 E.

		Longitudes	
Exam. V.	From *Jamaica*	76°	37′ W.
	To *Barbadoes*	58	55 W.
Rule 4.	Dif. Longitude	17	42 E.
Exam. VI.	From *London*	0	5 W.
	To *Lizard*	5	19 W.
Rule 4.	Dif. Longitude	5	14 W.
Ex. VII.	From *Constantinople*	28	51 E.
	To *Gibraltar* . .	4	58 W.
Rule 5.	Diff. Longitude	33	49 W.

☞ *The above Answers are according to the reputed Longitudes in the* New Seaman's Calendar, *revised and corrected from Journals by* W. Mountain, F. R. S.

N. B. The reputed Longitudes of these Places are still different, in different Authors, and when they will be fixed is uncertain.

More EXAMPLES of finding the Difference of Longitude by the NEW WAY of Reckoning the Longitudes from *Greenwich.*

		Longitude	
Exam. VIII.	From *Cape Farewell*	46°	50′ W.
	To *Admiralty Isle*	59	45 E.
Rule 5.	Dif. Longitude . . .	106	35 E.

		Longitude	
Exam. IX.	From *Bantam*	105°	5′ E.
	To Island *Juan Fernandes*	88	23 W.
		193	28 W.
Rule 5.	Dif. Longitude	166	32 E

		Longitude	
Exam. X.	From *Antigua*	61°	50′ W
	To *Porto Bello*	80	20 W.
Rule 4.	Dif. Longitude	18	30 W.

REMARKS on the different Beginnings of the *terrestrial* Longitudes.

1 IT has been observed, at *p.* 298, by *Newtonienfis,* that the *terrestrial* Longitudes ought to be reckoned from *Ferro,* one of the *Canary Isles,* according to ancient Custom; and that for the same Reason that the *cœlestial* Longitudes are reckoned from the Beginning of *Aries,* according to antient Custom. In which Computation of the terrestrial Longitudes, if all Nations agreed, the Confusion would be avoided now arising from the different Beginnings of Longitude among different Navigators in the same and different Nations.

2. The *Latitude* of each Place, on the Globe, begins at the Equinoctial on the Place's Meridian, and terminates on that Meridian at the Place whose Latitude is sought; by which, with Reference to the Equinoctial, the Quantity of each particular Latitude (of Places) is ascertained.

3. The *Longitude* of each Place, on the *Globe,* begins at some distant Meridian on the Equinoctial, where it is intersected by that Meridian, and terminates on the Equinoctial, where it is intersected by the Meridian, of the Place, whose Longitude is sought; by which, with Reference to some other Meridian, the Quantity of each particular Longitude (of Places) is ascertained.

4. Though reckoning the *terrestrial Longitudes* round the Globe *easterly,* from the Meridian of an *Observatory,* in any one Nation, would be equally easy, with reckoning from *Ferro,* for determining the Difference of Longitude betwixt any *two Places*; yet, by reckoning the Longitudes from *Ferro* only, according to original and antient Custom established, or from some other Meridian *universally agreed on,* we should be able to compare the absolute *Longitudes* ascertained by different Nations, as we now compare the Latitudes, and so arrive at a still nearer and nearer Improvement in both. And each Nation would be able to make the same Comparison and Improvement for themselves from what is done by other Nations.

5. The *Difference of Latitude* of two Places is counted on the Meridian of one Place, betwixt the Parallels of both Places.

6. The Difference of Longitude of two Places is counted on the Equinoctial, betwixt the Meridians of both Places.

7. On whatever Meridian betwixt two Parallels of Latitude, the Difference of Latitude be reckoned, it *is still the same in Quantity.*

8. By whatever Method the Distance on the Equinoctial, or Difference of Longitude is reckoned betwixt two Meridians, it *is still the same in Quantity,* which is the Affection of Longitude chiefly sought, and what is chiefly wanted, from whatever Beginning Longitude is reckoned.

9. The *cœlestial Longitudes* are only wanted from the Intersections of the Ecliptic and Equinoctial, at *Aries* or *Libra,* to which ever they happen to be nearest, for the Purpose of computing the *cœlestial Declinations* in Astronomy, to which the *terrestrial Latitudes* in Geography are correspondent and similar.

10. The

A JOURNAL of a VOYAGE

IN THE

DREAD-NOUGHT MAN of WAR,

Captain CONDUCT, *Commander*.

From the *Lizard* { Latitude 49° 55′ N. / Longitude 5 19 W. } To the *Island* of MARTINICO in the *West-Indies* { Lat. 14° 43′ N. / Lon. 61 00 W. from *Greenwich* Observat.

Difference of LATITUDE 35° 12′ S; *Difference* of LONGITUDE 55° 41′ W.

The *constant* COURSE S. 52° 23′ $\frac{1}{2}$ W. / Or S. W. 7 23 $\frac{1}{2}$ W. } DISTANCE on that *Course*, 3461′ Miles.

Began our Voyage on Thursday, *the* 8*th of* May, 1760.

Friday, *May* 9, 1760.

	Ho.	Courses steered.	Knots	Wind.	Courses corrected.	Points	Dist.
Afternoon.	2	W b. S	5.3	N	Sw.b.w$\frac{1}{2}$w	5 $\frac{1}{2}$	5′.3
	4	SW	5.0	NNW	SSW$\frac{1}{2}$W	2 $\frac{1}{2}$	15.9
	6		5.4	N			
	8		5.5				
	10	SW b. S	5.7	NW b. W	S b. W$\frac{1}{2}$W	1 $\frac{1}{2}$	5.7
	12	SW	6.0	NNW	SSW$\frac{1}{2}$W	2 $\frac{1}{2}$	28.0
After Midnight.	2		7.1	N b. W			
	4		7.6				
	6		7.3	N b. E			
	8	SW b. S	7.4		S b. W$\frac{1}{2}$W	1 $\frac{1}{2}$	7.4
	10	SW	6.5		SSW$\frac{1}{2}$W	2 $\frac{1}{2}$	11.9
	12		5.4	NE			

Courses.	Pnts.	Dist.	N.	S.	E.	W.
Sw.b.w$\frac{1}{2}$w	5$\frac{1}{2}$	5′.3	. . .	2′.50	. . .	4′.67
SSW$\frac{1}{2}$W	2$\frac{1}{2}$	55.8	. . .	49.21	. . .	26.30
S b.W$\frac{1}{2}$W	1$\frac{1}{2}$	13.1	. . .	13.39	. . .	4.06
Half { Sum			. . .	65.10	. . .	35.03
Half { Dif						
Total, doubled				130.20		70.06

On *Board* the *DREADNOUGHT*.

REMARKS and OCCURRENCES.

A Point $\frac{1}{2}$ Variation W.

Thursday, *May* 8, 1760, at Noon, the *Lizard*, by the Compass, bore NNE, Distance about 16 *Miles*. — Hence the *Course* steered from thence SSW, Distance 16 Miles. ∴ *Variation* 16° W. *Therefore*, *May* 8, at Noon,

Tr. Course	Dist.	Dif. Lat. S.	Dep. W.	Lat. N.	Lon. W.
S. 6° $\frac{1}{2}$ W.	16′	15′.89	1′.74	49° 39′	5° 22′

At 6 lost Sight of the *Lizard*, bearing NE b. N $\frac{1}{2}$ N.

At 10 *Scilly* LIGHT-HOUSE bore N $\frac{1}{2}$ E, Distance about 10 Leagues.

Heard a Firing of Guns to the Westward.

Blows hard. Took a *Reef* in our Top-sails.

Fell in with a *French* Privateer, at 5 this Morning, *la Rochelle*, of 30 Guns, and took her.

The *Experiment*, *Defiance*, *Intrepid*, *Enterprise*, and *Success*, in Company.

Fair Weather.

Passed by the *China* Indiaman, bound for *London*.

Twenty-four Hours RECKONING.

Course.	Dist.	Dif. Lat. N.	Dif. Lat. S.	Departure E.	Departure W.	Ship's Place Lat. N.	Ship's Place Lo. W.
S. 28° 17′ W.	147′.85	. . .	130′.20	. . .	70′.06	47° 29′	7° 8′
Correctn by Observn Reckg Head of Ship		. . .	. . .	. . .	—3′.76	+ 7′	— 6′
Corrected.		. . .	123.20	. . .	66.30	47° 36′	7° 2′

Sun's *Zenith Dist.* 30° 2′ N. | Sun's *Magnet. Ampl.* 12° 17′ E. N.
Sun's *Declination* 17 34 N. | Sun's *True Ampl.* 28 17 E. N.
Lat. by Observation 47° 36′ N. | *Needle's Variation* 16° W.

This Day, at Noon, *Martinico* bore S. 53° 53′ W. Dist. 3347′ Miles.

N. B. *If your* magnetical Variation *is to the* Right *or* Left *of the true Point or Azimuth*, (supposing yourself at the Center of the Compass) *you allow for it in the* true Course, *the same Way*, *to the Right or Left of the Course steered by the Compass*; *for the Course made good by the Ship*, *when there is no* Lee-Way. *But when there is* Lee-Way, *you also allow for that in your Course corrected by Variation*, *as aforesaid*, *by taking* (*from the Wind*) *as many Points distant from your* Course corrected by Variation, *as is equal to the* Lee-Way; *for the Course then made good by the Ship*.

HENCE *also*, *if the Variation be to the* Right *or* Left *of the true Point of the Compass*, *by a certain Quantity*, *you must steer as much contrariwise*, viz. *to* Left *or* Right, *of your* intended Course, *to make* that Course *good by the Ship*, *independent of* Lee-Way; *or so much more to be allowed for towards the Wind*, *if the Distance of the Ship's Course from the Wind will admit*.

10. The *cœlestial Latitudes* have no correspondent *terrestrial* Affection, or Property. And therefore the *supposed Causes* for the Difference in (Reckoning) the Beginnings of cœlestial and terrestrial Longitudes, by *Astronomers* and *Navigators*, respectively, in Use, are these two: 1. From the Equinoctial and Ecliptic Intersection, requiring that Beginning for Computation in *Astronomical* Purposes. 2. For the Purpose of Navigation; requiring the Beginning of Longitude at each Country's *Metropolis*, or *Observatory*, for adjusting the *cœlestial Longitudes* R. A. and Declinations correspondent thereto, to those under *different Meridians*, having the *Diff. of Long.* at once given, for the Purpose of Navigation. Whereas to find the *Diff.* of Long. had been a *Problem*, when the Long. is reckoned according to *antient Custom*, and what would embarrass the Navigator; being attended with more Inconveniency to Astronomy than Reckoning the Longitude from an Observatory (to which the *cœlestial Longitudes*, *Declination*, and *Right Ascensions* are given) in any particular Nation. Reckoning Longitude from the *Lizard* is a Problem concerned only in a *Ship's Reckoning*, for comparing the Ship's Distance from her Port, and not concerned in her Longitude from *Greenwich*, which Geographical Longitude is wanted in all foreign Places, or Places on the Sea Coasts, remote from *Greenwich*, to compare with the geographical Longitude obtained from *cœlestial Observation*. Therefore the Longitudes from *Greenwich* in our Sea-Coast Table are given.

A JOURNAL of a VOYAGE from *England* to *MARTINICO* in the *West-Indies*.

Saturday, *May* 10, 1760. — On *Board* the *DREADNOUGHT*.

	Ho.	Courses steered.	Knots	Wind	Courses corrected.	Points	Dist.
Afternoon.	2	S. W.	6.6	N. N. E.	SSW $\frac{1}{2}$ W	2 $\frac{1}{2}$	6′.6
	4	S.S.W.	6.2		S. $\frac{1}{2}$ W.	$\frac{1}{2}$	12.5
	6		6.3				
	8	SWb.S	7 0	N.E.b.N.	Sb.W$\frac{1}{2}$W	1 $\frac{1}{2}$	7 0
	10	S. W.	7.1	N. E.	SSW $\frac{1}{2}$ W	2 $\frac{1}{2}$	21.4
	12		7.3	N. b. E.			
After Midnight.	2		7.0	N N E			
	4	SW b.S	7.5	N E *b.* N	Sb.W$\frac{1}{2}$W	1 $\frac{1}{2}$	
	6	S W	7.1	N N E	SSW$\frac{1}{2}$W	2 $\frac{1}{2}$	26.2
	8		7.0	N E			
	10		6.1				
	12		6.0	E N E			

Remarks and Occurrences.

A great Sea setting after us S.

1 $\frac{1}{2}$ Point Variation W.

Saw a *Sail* to the N. E.

Spoke with the *Mermaid* bound for *Legborn* from *London*.

Squally, with *Rain*.

Rain. Spoke with the *Two-Sisters* bound for *Yarmouth*, from *Gibraltar*.

Squally.

Gave Chace at 4 to a large Sail upon our *Starboard* Bow, proving to be the *Dragon* Man of War on a Cruise.

A fresh Gale, and fair Weather.

Spoke with the *Guardalupe*, bound for *London*, from *Antigua*.

A *Current* setting S. E. 5 Hours, 2 Miles an Hour.

Count for the Half Time only, where the Log. is doubled.

Courses	Pnts	Dist.	N.	S.	E.	W.
S S W $\frac{1}{2}$W	2$\frac{1}{2}$	54′.2	. . .	47′.80	. . .	25′.55
S $\frac{1}{2}$ W	$\frac{1}{2}$	12.5	. . .	12.44	. . .	1.23
S b. W$\frac{1}{2}$W	1$\frac{1}{2}$	7.0	. . . .	6.70	. . .	2.03
Current. E S E $\frac{1}{2}$ S 2 $\frac{1}{2}$ Hours	5$\frac{1}{2}$	5.0	. . . . .	2.36	4.41	. . .
Half Sum				69.30	4.41	28.81
Half Dif.						24.40
Total, Doubled				138′.60		48′.80

Twenty-four Hours RECKONING.

Course	Dist.	Dif. Lat. N.	Dif. Lat. S.	Departure E.	Departure W.	Ship's Place Lat. N.	Ship's Place L. W.
S. 19°. 24′ W	146′.92	. . .	138′. 60	. . .	48′.80	45° 17′	8° 12′
Correction by Observ. Ship Head of Reck g.		. . .	+15.00	. . .	+ 5.28	− 15	+ 8′
Corrected.		. . .	153′.60	. . .	54′.08	45° 2′	8° 20′

⊙ *Zenith Distance* 27° 13′ N
⊙ *Declination* 17 49 N
Lat. by Observation 45 2 N

⊙ *Magnet. Ampl.* 10° 30′ E. N.
⊙ *True Ampl.* 26 20 E. N.
Needle's Variation 15 50 W.

This Day, at *Noon*, *Martinico* bore S. 55° 54′ W. Distance 3044′ Miles.

Sunday, *May* 11, 1760. — On *Board* the *DREADNOUGHT*.

	Ho.	Courses steered.	Knots	Wind	Courses corrected.	Points	Dist.
Afternoon.	2	S b. W	5.8	W.	Sb.E $\frac{1}{4}$ E	1 $\frac{1}{4}$	11′.4
	4		5.6	Wb.S			
	6	S S E	5.5	S. W.	SE $\frac{1}{4}$ E	4 $\frac{1}{4}$	11.4
	8		5.9				
	10	NW*b*.W	6 6		NWb.W$\frac{1}{4}$N	5 $\frac{1}{4}$	20.7
	12		6.8				
After Midnight.	2		7.3				
	4	S S W	5.5	W	S $\frac{1}{4}$ E	$\frac{1}{4}$	10.6
	6		5.1				
	8	E S E	4.8	S b.W	E $\frac{1}{4}$ N	7 $\frac{3}{4}$	4 8
	10	S S W	5.0	S. E.	S S W $\frac{1}{4}$ S	1 $\frac{3}{4}$	5.0
	12	E b. S	5.3	S b. E	E b. N $\frac{1}{4}$ N	6 $\frac{3}{4}$	5.3

Remarks and Occurrences.

1 $\frac{1}{4}$ Point *Variation* W. 1 Point *Lee-Way*.

A great *Sea* following us, S.

Spoke with the *Turkey-Merchant*, bound for *London*, from *Naples*.

Cloudy.

Lightning and *Thunder* from the S. W.

Rain.

Rain. Passed by the *Jamaica Frigate*, bound for *London* from *Jamaica*.

Squally.

Spoke with the *Nightingale* from *Virginia* for *London*.

Came up with the *London-Merchant*, an *English Privateer*.

Fair Weather.

A *Current* setting N. W. by W. 4 Hours, 3 Miles an Hour.

Count for the Half Time only; the Log. being here *doubled*.

Courses	Pnts	Dist.	N.	S.	E.	W.
S b. E $\frac{1}{4}$ E	1$\frac{1}{4}$	11′.4	. . . .	11′.06	2′.77	. . .
S E $\frac{1}{4}$ E	4$\frac{1}{4}$	11.4	10′.64	7.65	8.45	. . .
SW*b*.W$\frac{1}{4}$W	5$\frac{1}{4}$	20.7	. . .	. . .	. . .	17.75
S $\frac{1}{4}$ E	$\frac{1}{4}$	10.6	. . . .	10.58	0.52	. . .
E $\frac{1}{4}$ N	7$\frac{3}{4}$	4.8	0.23	. . .	4.79	. . .
S S W $\frac{1}{4}$ S	1$\frac{3}{4}$	5.0	. . . . .	4.70	. . .	1.68
E b. N $\frac{1}{4}$ N	6$\frac{3}{4}$	5.3	1.29	. . .	5.14	. . .
W. N W	6	6.0	2.29	. . .	. . .	5.54
Half Dif.			14.45	33.99	21.67	24.97
Half Sum				19.54		3.30
Total, Doubled				39.08		6.60

Twenty-four Hours RECKONING.

Course	Dist.	Dif. Lat. N.	Dif. Lat. S.	Departure. E.	Departure. W.	Ship's Place Lat. N.	Ship's Place Lo. W
S. 9°. 35′ W	39′.64	. . .	39′.08	. . .	6.60	44° 23′	8° 29′
Correct^n by Observ^n Reck g Head of Ship		. . .	−9.00	. . .	− 1.52	+ 9	− 2′
Corrected.		. . .	30′.08	. . .	5′.08	44 32	8° 27′

⊙ *Zenith Dist.* 26° 27′ N
⊙ *Declination* 18 5 N
Lat. by Observation 44 32 N

⊙ *Magnet. Ampl.* 40° 47′ W N
⊙ *True Ampl.* 26 27 W N
Needle's Variation 14 20

This Day, at Noon, *Martinico* bore S. 56° 22′ W. Dist. 3229′ Miles.

Nearness.

Nearness of SAILING to the WIND, and Resolving a TRAVERSE geometrically.

☞ *If a Ship plies to Windward, and is close hauled, it is usual to allow* 1 *Point, from the Wind, for Lee-Way; when she lies within* 5 ½ *Points of the Wind, viz. on either Side that Point of the Compass from whence the Wind blows; making a Course good* 6 ½ *Points from the Wind. But when there is no* Head Sea *to make her fall off from her Course, the nearest she can lie to the Wind is reckoned about* 5 *Points, on either Side of it; then making her Course good about* 6 *Points from the Wind: (Currents, Hard Gales, and High Seas excepted) Otherwise, she may sail large (as 'tis called) with the Wind more or less abaft the Beam.*

When the Wind blows directly aft, a Ship is then said to go right before the Wind, as to every experienced Seaman *is known.*

IN Imitation of the *Common Form* or *Custom* of Keeping a *Ship's Journal,* the *Log* is here heaved but *every* 2 *Hours*; though on Board most of our *Men of War* and *East India Ships,* it is generally heaved *every Hour,* for ascertaining the *Distances* run on the several Courses as near as possible. And therefore one Side of a *Page* in your *Journal Book,* being ruled for every Hour, instead of every two Hours, to contain one, instead of 2 Days Reckoning in each Page, your Ship's Place will be deduced more *circumstantially,* though perhaps *not more exactly*: Since its Place derived either from *every Hour,* or 2 *Hours heaving the Log,* must be duly corrected by Observation.

In plying to Windward, you may lay down your *several* Courses and Distances of the *Traverse* on Paper, by *Scale* and *Compasses,* and so determine, by the same *Scale* and Line of *Chords,* the *whole* Course and Distance, as well as *whole* Difference of Latitude and Departure, from the several Courses and Distances given, as follows.

RULES *for laying down and Resolving a* SHIP's TRAVERSE *by the Line of* CHORDS, *with* SCALE *and* COMPASSES.

Cases.	Northing and Southing, Easting and Westing.	Condition of Courses.	∠ between each 2 Courses.
1	2 *Meridians,* 2 *Parallels*	*Subtract* less from greater *Course.*	For the Points or Angle, between the Distances on each two succeeding Courses.
2	2 *Meridians,* 1 *Parallel*	*Add* both *Courses.*	
3	1 *Meridian.* 2 *Parallels.*	Subtract the Sum of both *Courses* from 16 Points.	
4	1 *Meridian,* 1 *Parallel*	*Add* 8 Points, the less Course, and Supplement of greater.	

☞ N. and S. are called *Meridians,* and E and W. are called *Parallels,* in the Courses.
Supplement is what a *Course* wants of 8 Points or 180°.
To know the *Meridians, and Parallels,* the *First* and *Second, Second and Third, Third* and *Fourth,* &c. Courses, are compared together.

EXAMPLE.

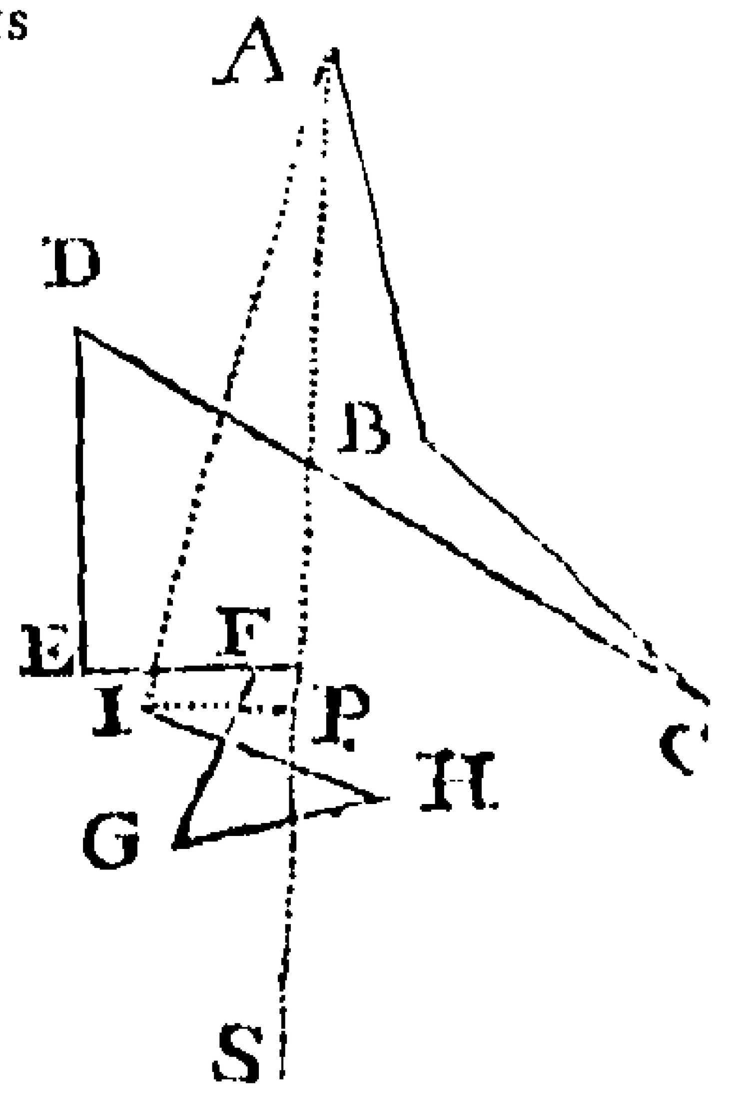
Compared	No.	Course	Points fr. Merid	Points for plang	Dist. doubled
	1	S. by E. ¼ E.	1 ¼	1 ¼	22′,8
1 and 2	2	S.E. ¼ E.	4 ¼	13 by Case 4	22,8
2 and 3	3	N.W. by W. ¼ W.	5 ¼	1 1	41,4
3 and 4	4	S. ¼ E.	¼	5 1	21,2
4 and 5	5	E. ¼ N.	7 ¾	8 2	9,6
5 and 6	6	S. S. W. ¼ S.	1 ¼	6 1	10,0
6 and 7	7	E. by N. ¼ N.	6 ¾	5 1	10,6
7 and 8	8	W. N. W.	6	3 ¾ . . 3	12,0

These several *Distances* being laid down, or planned, according to the first ∠ 1 ¼ Point with the *Meridian,* and the ∠ of each *succeeding Distance* with the *former,* as in the 2 last Columns, you will find the *whole Course* and Dist. and *whole* Dif. of Lat. and Departure as in the foregoing Page.

An *exact Geometrical* PROJECTION of the *DREADNOUGHT*'s TRAVERSE, 11th of *May,* 1760, according to the *foregoing* RULES.

Distances	Points
AB = 22.8	∠ SAB = 1 ¼
BC = 22.8	∠ ABC = 13
CD = 41.4	∠ BCD = 1
DE = 21.2	∠ CDE = 5
EF = 9.6	∠ DEF = 8
FG = 10.0	∠ EFG = 6
GH = 10.6	∠ FGH = 5
Current, IH = 12.0	∠ GHI = 3 ¾

Whence, IP = 66 = Departure W.
PA = 39.1 = Dif. Lat S.
AI = 39 6 = Dist. run.
∠ SAI = 9° 35′ W. = the Course.



N. B. A S *is a North and South Line*; N. *at Top*; S *at Bottom.* E *to the Right*; W *to the Left.*

Of the TRADE WINDS, and MONSOONS.

PLACES where the WINDS are partly *constant*. . . TIMES and PERIODS of blowing. . . . DIRECTIONS of blowing.

In open Seas where there is no Interruption from interposing High-Lands, the *Trade-Winds* and *Monsoons* blow as underneath.

1. *Between the Tropics* to Lat. 30° N. and S. . . . *All the Year constantly*. . . . . . *Easterly Wind blows.*

Which Wind, but for Interruptions of *Mountains* and *High Land* on the opposing *Continents*, would blow quite round the Globe. And without these *Limits*, which are narrow, this Wind changes *instantaneously*.

Places	Times	Directions
2. *From* 30° *to* 35° *Lat.*	All the Year	*Westerly Wind blows.*
3. *Near the Tropic of* Cancer	All the Year	N. *Easterly.*
4. *Near the Tropic of* Capricorn	All the Year	S *Easterly.*
5. *Sun near the Tropic of* Cancer	All Summer	*Wind a Point or two more Southerly.*
6. *Sun near the Tropic of* Capricorn	All Winter	*Wind a Point or two more Northerly.*

☞ The Sea generally follows the Direction of these Winds. In the *Pacific Ocean*, the Winds are very fresh, and regular, so as to require little Attendance on the Ship's Sails; and Storms and Tempests are seldom here known.

Places	Times	Directions
7. *On the Coast of* Peru, *the West of* Africa, *Lat.* S *and* 100 *Leagues from* Guinea *Coast*	All the Year	*Southerly Wind blows.*
In the Atlantic *and* Æthiopic *Ocean, Coast of* Africa *to* 28° N. *and* S. *Lat. And On the* Americ. *Coast fr.* 31° N. *to* 4° N. *Lat.*	All the Year	S. *Easterly Wind blows.*
Near the Coast of Brasil, *in* America	All the Year	*Wind more Easterly* than
Near the Coast of Africa, *in same Latitude,* where,	All the Year	*The Wind more Southerly,* the [on the *American* Coast.
8. *On* S. *Coast of* Guinea, *fr.* Sierre de Leon *to St.* Thomas's Isle	Perpetual	*Wind Southerly and* S. *Westerly.*
Where are frequent *Calms* and *Tornados.*		
9. *Latitude* 10° *on* Guinea *Coast*	All the Year	*West.*
10. *Latitude* 20 *or* 30°	All the Year	*North West.*
11. *Between* 4 *and* 10° N. *Lat. a* Tract of Sea, *called the* Rains . . . 100 *or* 150 *Leagues fr.* Guinea-*Coast*	Perpetual	*Calms,* attended with Thunder and [Lightning, and frequent Rains.

Near the Caribbe-Islands . . Hurricanes, in *August* . . *Wind more Easterly, sometimes* E. *or* E. *by* S. *but commonly a Point or* [*two to Northward.*

These Winds gradually decrease their Strength, sailing to the *Westward.*

Places	Times	Directions
12. *On the* Brasil *Coast*	*From* April	*South-West Wind blows.*
	From September	*North-East.*
To South of Brasil	All the Year	*Wind more Westerly.*
13. *On the West Coast of* America		*Westerly.*
14. *In the* Indian *Ocean*	*Partly* general, *as in the* Æthiopic *and* Atlantic *Sea.*	
From Lat. 10° *to* 30° *Lat.* S.	*Partly* periodical . . All the Year	S. E. *by* E. *Wind blows.*
15. *From* 2° *to* 10° *Latitude* S. As far as the *Molucco* Islands. A Degree more, near *Java,* and a Degree less near *Madagascar.* — MONSOON	*From* June *till* November	*South-East Wind blows.*
	From December *till* May	*North West.*
16. *From* 3° S. *Latitude Northwards*	*From* October *till* April	*Clear Breeze North-East.*
	From April *till* October	*South-West or* S. S. *West,* at- [tended with Rains, and stronger of the two.

But these Winds are less constant in the *Gulf* of *Bengal* than in the *Indian* Sea.

Places	Times	Directions
17. *Between* Madagascar *and* African *Coast, as far as the* Equinoctial	*From* April *to* October	S. S. *West Wind blows, but more* [*Westerly near the* Line.
	Rest of the Year	*Easterly.*
18. *To the* East *of* Sumatra, *the Coast of* Cambaia, *and* China, *as far as the* Philippine *Islands and* Japan	*From* November *till* May	*North Wind blows.*
	From May *till* Oct. *or* Nov.	*South Wind,* varying a Point or [two at Times.

19. *Between* New Guinea *and* Sumatra, South of the Equinoctial, North Wind changes North-westerly, South to South-easterly, varying sometimes 5 or 6 *Points.*

☞ The Time of these Winds changing is a Month or 6 Weeks later than their Times of blowing on the forementioned Coasts.

Places	Times	Directions
20. *Between the* S. *End of* Madagascar *and the Shore*	*From* October *till* May	*South-East Wind blows.*
	From May	*West Wind.*
21. *Beyond St.* Lawrence, (otherwise called *Madagascar*) *into the Sea*		*South Wind.*

Of the TRADE WINDS, and MONSOONS.

REMARK. These *contrary* Winds shift not suddenly. In some Places they change to *Calms*; in others to *variable* Winds.

THE End of the *Westerly Monsoon* on the Coast of *Coromandel*, and the two *last Months* of the *Southerly Monsoon*, in the *Chinese* Sea, are generally *tempestuous*; so as to make the Navigation in these Seas very hazardous, at the *breaking up of these* Monsoons; for so these *Tempests* are called.

☞ *In the temperate* Zones, *at all Times of the Year, the variable Winds blow from all Points of the Compass. And near the* Sea-Coasts, *the Winds blow with different* Forces *and* Directions, *by the Land differently reflecting Heat, and interrupting the Course of those Winds.*

THE *Winds*, that *constantly* blow *from*, or *nearly from*, some certain Point of the Compass, are called *Trade Winds*: and such are the *Winds* Ships get into bound to the *West Indies*.

If these *Trade Winds* blowing, for a certain Time, in a constant Direction, or near it, shift their Direction, *periodically*, at a certain Time of the Year, and then blow *contrary*, they are called *Monsoons*: and such are the *Winds* Ships get into bound to the *East Indies*.

Experienced Navigators, bound to the *West Indies*, even to the Coast of *America*, are more sollicitous to run into the Latitudes where these *Trade Winds* blow to favour their Passage through those Seas, than to attempt a *directer Course* and be retarded in their Voyage by contrary or adverse *Winds*, as they may happen to blow. And by getting into these *Trade Winds*, to command what Course they please, having the *Wind* always more or less *abaft* the Beam, they find it *commodious to run down their Latitude*, before the Ship comes near the intended *Port* or *Island*; and then they steer upon a *Parallel* (directly E. or W.) by which they are sure to *hit their Port designed*. Whereas the *Island* of *Barbadoes*, as well as other Places lying in the open Ocean, have sometimes been *mist*, or over run, by the *Inch or two Marksmen*, the *hair splitting* and *direct Navigators*; who, being homeward bound, sometimes run their Ship on the *Rocks* of *Scilly*, instead of *hitting the Lizard*.

For sailing into the English *Channel, in homeward bound Voyages, see Directions by Captain* Robert Brown, *of the Navy, further on, recited from our* History of the Islands of Scilly, *for the* Navigator's *Purpose*.

This *Art* of conducting a Ship in the *Trade Winds*, by a remoter Course, to make the *quicker* Passage, is known to the experienced Seaman; but is a Secret to the *Land Navigator*, (for whose Sake we insert it) that never made a Voyage to prove the Use of his *refined Theories*, and put his *infallible* Land-Rules in *Practice*.

If Ships, bound to, or from, the *East Indies*, arrive at the Place of a *Monsoon* too late for their Passage, when that *Monsoon* is shifted the contrary Way of the Voyage, they are forced to return to the next *convenient* Port, and there wait, *some Months*, for the Return of the *contrary Monsoon*, before they can pursue their Voyage. Whereas, if Ships rightly time their coming to the Place of the *favourable Monsoon*, they hasten their Passage through those Seas, and accomplish their Voyages in the *shortest Time*.

Of these different Sorts of *Trade Winds*, you may observe, that some blow from E. to W. some from S. to N. others from W. to E. — Some are constant in *one Quarter* all the Year; some blow one Half the Year *one Way*, and the other six Months quite *contrary*. Others blow six Months one Way, and then shifting only eight or ten Points, continue there six Months more, and then return again to their former Stations, as all these *shifting* Trade-Winds do; and so, as the Year comes about, they alternately succeed each other, in their proper Seasons.

There are other Sorts, called *Sea Winds* and *Land Winds*, differing much from any of the former, the one blowing by Day, the other by Night, constantly and regularly succeeding each other.

Within the *Torrid Zone* also are *violent Storms*, as fierce, if not fiercer than any are in *other Parts* of the World: And as to the *Seasons* of the Year, they are distinguished in these Parts only by *Wet* and *Dry*, (there never being Frost or Snow) which *wet* and *dry* Seasons do as successively follow one another, as the *Winter* and *Summer* do with us in *England*.

Here are also *strong Currents*, sometimes setting one Way, sometimes another; which though it is difficult to describe, with desirable Accuracy, yet we have attempted to give a particular Account of these Matters, from our own Observations, and the Authority of others, further on.

VARIATION of the COMPASS observed at different Times and PLACES.

Places Names	Variation.	Place's Names	Variation
Ascension Isle	1° W.	*London*	16° W.
Azores Isle	8 W.	*Madagascar*, W. Coast	19 W.
Baffin's Bay	57 W.	*Madagascar*, S. fr. Lat. 40°	25 W.
Baltic	10 W.	*Majorca* Isle	16 W.
Barbary, N. W. Coast	7 W.	*Maldavia* Isles	10 W.
——— N. E. Coast	5 W.	*Malacco*	2 E.
Bombay	8 W.	*New England* Coast	10 W.
Brasil Coast, Lat. 18° S.	6 E.	*Newfoundland* Coast	21 W.
——— Lat. 20° S.	12 E.	*New Guinea* Coast	6 E.
British Channel	15 W.	*New Holland*, S. and W. Coast	4 W.
Canary Isles	7 W.	*New Zealand*	9 E.
Cape Comerin	5 W.	*Portugal* Coast	9 W.
—— *Frio*	12 E.	——— W. 8°	6 W.
—— *of Good Hope*	16 W.	*River Grand* before	14 E.
Chili, West Coast	8 E.	—— *Plate* before	19 E.
England, Westward at Sea	12 W.	St. *Helena*	2 W.
France, W. Coast	11 W.	*Sardinia*	13 W.
——— Westward at Sea 10°	8 W.	*Sicily*	12 W.
German Ocean	14 W.	*Straits of Gibraltar*	6 W.
Guinea, S. Coast	5 W.	—— *Magellan*, E. Entrance	15 E.
Gulph of *Bothnia*	6 W.	——— W. Entrance	13 E.
Hudson's Bay	30 W.	*Terra Magellanica*, E. Coast	19 E.
——— *Straits*	40 W.	*Tristian de Cunha* Isle	0
Java Coast	2 W.	*Van Diemens*, Land	1 E.
Indian Sea	14 W.	*Virginia*	5 W.

N. B. As there is a *continual* Variation of the Variation of the Compass, the *Magnetic* Variations here inserted, are more for *Curiosity* than they are to be *depended* on; being the same as in Mr. *Emerson*'s *Navigation*. And therefore the *Navigator* should take the *Magnetic Variation* every Day, or as often as he finds it convenient at Sea, for determining his true *Course*, and keeping a *good Reckoning*.

☞ See *Variation Table* by *Mr. W. Mountain*, F. R. S. in *Philosophical Transactions*.

REMARKS *on the* Vulgar ERROR *in Books of* Navigation, *of supposing* MERIDIONAL DISTANCE *and* DEPARTURE *to be* alike, *and of a* FIXED QUANTITY.

☞ IN keeping a *Ship's Journal*, according to *Atkinson's Epitomy*, or *Art of Navigation*, the *whole* Departure or Difference of *Easting* or *Westing* is all along, in the daily Reckonings, reduced into *Degrees* and *Minutes*, by dividing the Departure of each daily Reckoning by 60. And these Degrees of Departure are *very erroneously* called by Mr. *Atkinson*, the Meridional Distance; being of another Nature to what Departure is.

Mr. *Martin*, in his *Sphæroidal Navigation*, falls into the same *Error*, by making *Departure* from the first Meridian to be the *Meridional* Distance from that Meridian.

And Mr. *Mountain*, F. R. S. has settled his Longitudes of Places in the *West-Indies* (See *p.* 242, *Seaman's Compass rectified*, 1759.) by the *Meridional Distance* from *Barbadoes* to the *Lizard*, according to the *Journals* of experienced *Mariners*; which *Journals*, however, of Departure, for Meridional Distance, in long Voyages, can produce no Certainty: Since there may be as many *different Departures, betwixt any two remote Places, as there are* different *Courses steered betwixt them. And these Departures will differ more or less, according as the different Courses in sailing betwixt the two Places, be nearer to the Meridian, or to an* E. *or* W. *Parallel.*

1. For, in Sailing towards the *Pole*, if a Ship directs her Course N. or S. till she arrives in the Parallel of Latitude of the *Port designed*, and then pursues an E. or W. Course, till she arrives at her Port, the Departure by these Courses will be the *least possible*.

2. And if she directs her Course E. or W. in the Parallel of Latitude of the Place departed from, till she arrives in the Difference of Longitude of the Port designed, and then pursues a N. or S. Course, she will make the *greatest Departure* possible.

3. On the contrary, if a Ship sails directly S. or N. (according as the Place sailed from is N. or S. Latitude) towards the *Equinoctial* on this Side, till she arrives in the Parallel of Latitude of the Port designed, and then pursues an E. or W. Course, she will make the *greatest Departure* possible.

4. But, if she sails E. or W. in the *Parallel* of Latitude of the Place *departed from*, towards the Equinoctial, on this Side of it, till she arrives in the Difference of Longitude of the Place designed, and then pursues a S. or N. Course, she will make the *least Difference* of Departure possible.

5. Again, in Sailing betwixt one Latitude N. and the other S. across the Equinoctial, a Course directly on the Meridian betwixt the two Latitudes, and then an E. or W. Course, the Difference of Longitude, will make the Departure the *least*, provided the Latitude sailed from be the less.

6. But if the Latitude sailed from is the *greater*, then a W. or E. Course, the Diff. of Longitude, and a Course on the Meridian to the Place designed will give the *Departure* the *least*.

7. And sailing from one Latitude to the Equinoctial, then the Dif. of Longitude on the Equinoctial, and then on the Meridian to the other Latitude, *(on 3 different Courses)* will make the Departure always the *greatest* possible.

INFERENCE. But one Course (if *practicable*) betwixt any two Places on the Globe, will make the same Departure, or a *Middle Departure*, betwixt the *greatest* and *least* Departures in sailing backward or forward by 2 or 3 different Courses. So that, from hence, it is clear, that Ships may make as many different Departures as they make different Courses betwixt these 2 or 3 Courses, that make the *greatest* and *least* Departures. Q. E. D.

The Nature of *variable Departure* between two Places being shewn as above, the *Meridian* or *Meridional Distance* between two Places will be the *fixed Distance* of their Meridians, at the Place sailed to, on a direct E. and W. Parallel. Which *Meridional* Distance is always equal to the *least Departure*, in sailing towards the Pole, but to the *greatest Departure* in sailing from the Pole, towards the Equinoctial. *See Remark p.* 276 *of this Work. See also pages* 68 *and* 69 *of Mr.* Emerson's *Navigation*, for the *Distinction of Meridional Distance and Departure.*

☞ INDEED, The Sum of all the Meridional Distances, made in Sailing, will be equal to the Sum of all the Departures, in which Sense only Meridional Distance and Departure are synonimous, or import the same, which Departure or Meridional Distance, is, however, proved to be very different in long Voyages; Because the same Courses and Distances, all the Way, are never pursued.

A TABLE shewing the *Miles* or *Minutes* of the Equator, that *make a* Degree *of Longitude in any Latitude.*

Degs of Lat.	Minutes.	Degs of Lat.	Minutes.	Degs of Lat.	Minutes.
1	59.99	31	51.43	61	29.09
2	59.97	32	50.88	62	28.17
3	59.92	33	50.32	63	27.24
4	59.86	34	49.74	64	26.30
5	59.77	35	49.15	65	25.36
6	59.67	36	48.54	66	24.41
7	59.56	37	47.92	67	23 45
8	59.42	38	47.28	68	22.48
9	59.26	39	46.62	69	21.50
10	59.08	40	45.95	70	20.52
11	58.89	41	45.28	71	19.54
12	58.68	42	44.95	72	18.55
13	58.46	43	43.88	73	17.54
14	58 22	44	43.16	74	16.53
15	57 95	45	42 43	75	15.52
16	57.67	46	41 68	76	14.51
17	57.37	47	40.92	77	13.50
18	57.06	48	40.15	78	12.48
19	56.73	49	39.36	79	11.45
20	56.38	50	38.57	80	10.42
21	56.01	51	37.76	81	9.38
22	55 63	52	36 94	82	8.35
23	55.23	53	36.11	83	7 32
24	54.81	54	35.26	84	6.28
25	54.38	55	34.41	85	5.23
26	53.93	56	33.55	86	4.18
27	53.46	57	32.68	87	3.14
28	52.97	58	31.79	88	2.09
29	52 47	59	30.90	89	1.05
30	51.96	60	30.0	90	0.00

DIVISION of the OCEAN.

EASTERN, or *Oriental* Ocean; WESTERN, or *Occidental*; NORTHERN, or *Septentrional*; SOUTHERN, or *Meridional* Ocean.

Other *Seas* take their Names from the *Continents* or Countries they wash; or from the *Nature* of those Seas.

As *Chinese Sea*, from adjacent Country of *China*.

Indian Sea, washing the *Indian* Shore.

Persian Sea, washing the *Persian* Shore.

Arabian Sea, washing the *Arabian* Shore.

Æthiopian Sea, washing the *Æthiopic* Shore.

Atlantic Sea, from *Atlas*, a huge Mountain in *Africa*, against which lies *Mar del Nort*, lying to the N. of *America*.

Mar del Zur, lying to the S. of *America*, or *Pacific Ocean*, from its Calmness.

Oceanus Hyspanicus, or *Spanish Sea*, washing the Coast of *Spain*; called also *Bay of Biscay*, by the *English*.

English Channel, between *England* and *France*.

Irish Sea, or St. *George's Channel*, between *England* and *Ireland*.

German or *British Ocean*, between *England* and *Holland*.

Caledonian Sea, Northward of *Scotland*.

Hyperborean, or *Frozen Sea*, beyond the *North Cape*.

Tartarian Sea, or *Scythian Ocean*, far Eastward, &c.

Baltic Sea, between *Denmark*, *Sweden*, and *Germany*, whose Entrance is called the *Sound*.

Mediterranean, or *Straits*; called *Levant* by the *Spaniards*.

The Entrance is called *Straits of Gibraltar*.

Pontus Euxinus, or *Black Sea*, joining to *Palus Meotis*, or *Mar del Zabeche*.

Caspian, or *Hircanian Sea*.

Arabian Gulph, or *Red Sea*.

Persian Gulph, or *Gulph de Elcatif*.

Division of the Earth and Ocean.

DIVISION of the EARTH.

Four Continents, EUROPE, ASIA, AFRICA, AMERICA.

EUROPE Bounded.

To the North, by the Northern Ocean, or frozen Sea; on the South by the *Mediterranean Sea* lying betwixt it and *Africa*; on the East by the River *Tanais*; on the West by the *Western*, or *Atlantic Ocean*.

Divided into Chief *Regions*.

Poland, *Muscovia*, *Sweden*, *Norway*, *Denmark*, *Germany*, *France*, *Spain*, *Holland*, *Flanders*, *Portugal*, *Italy*, *Hungary*, *Sclavonia*, *Greece*, *Dalmatia*, *Romania*, little *Tartary*.

Chief Islands.

Great-Britain, *Ireland*, *Sardinia*, *Sicily*, *Corsica*, *Candia*, *Negropont*, *Cyprus*.

ASIA Bounded.

On the North by the Northern and *Tartarian Sea*; on the South by the *Adriatic Gulph*, or *Red Sea*; on the East by the *Indian Ocean*; and on the West by the River *Tanais*.

Divided into Chief Provinces.

Turkey in Asia, *Arabia*, *Tartary*, *Persia*, *Natolia*, *Mesopotamia*, *Assyria*, *Chaldea*, *Syria*, *Armenia*, *Palestine*, *Georgia*, *Media*, *Parthia*, *China*, *India*.

Chief Islands.

Japan, *Sumatra*, *Borneo*, in the *Oriental Ocean*; *Rhodes*, in the *Mediterranean Sea*; *Metelino*, *Scio*, *Samos*, &c. in the *Archipelago*, and *some Islands* in the *East-Indies*.

AFRICA Bounded.

On the North by the *Mediterranean*; on the East by the *Red Sea*; on the South by the *Æthiopic* or *Southern Ocean*; and on the West by the *Atlantic Ocean*.

Divided into Chief Provinces.

Ægypt, *Barbara*, *Monomatapa*, *Desarts of Zara*, *Negroland*, *Biledulgerid*, *Nubia*, *Guinea*, *Æthiopia*, or *Abyssinia*.

Chief Islands.

The *Canary* Isles, *Cape De Verd* Isles, Isles of *Azores*, *Madeira* Islands, St. *Thomas*, *Madagascar*, or St. *Lawrence*, *Malta*, in *Mediterranean*, St. *Helena*.

AMERICA Bounded.

On the North by the *Northern Ocean*; on the East by the *Atlantic Ocean*; on the South by the *Magellanic Sea*; and on the West by the *South-Sea*, or *Mar del Zur*.

Divided into *North America*.

Chief Provinces.

New Spain, *Florida*, *Carolina*, *Virginia*, *Maryland*, *Pensilvania*, *New Jersey*, *New York*, *New England*, *New France*, *Greenland*, whether Continent or Island yet unknown.

The Chief Islands of *North America*.

Iceland, *California*, *Newfoundland*, *Bermudas*.

Into *South America*.

Chief Provinces.

Magellan, *Brazil*, *Chili*, the *Amazons*, *Guiana*, *Peru*, *Panama*, *Carthagena*, *Peraguay*, or *Rio de la Plata*.

Chief Islands of *South America*.

Terra del Fuego, *Hispaniola*, *Cuba*, *Jamaica*, *Porto Rico*, *Bahama*, *Bermudas*, *Barbadoes*, and the Rest of the *Caribbee* Islands. *Moluque*, or *Molucca* Islands, *Java* the *Greater*, *Java* the *Less*, and other numerous Islands in the *East Indies*.

☞ *From the Division of* America *as above, it appears that great Part of* South America *lies in* North Latitudes.

See Gordon's *geographical Grammar, for further Satisfaction.*

AFFECTIONS

AFFECTIONS of *Spherical* TRIANGLES in *general.*

1. EVERY great *Circle divides the Globe into two equal Hemispheres.*
2. *Any two* great *Circles cutting each other, make the* opposite *Angles equal.*

Of ANGLES.

In ANY Spherical TRIANGLE,

1. *The* external *Angle is less than the Sum of the* interior *opposite Angles.*
2. *The* Sum *of any two Angles is* greater *than the Supplement of the* 3d *Angle.*
3. *The greatest Angle is opposite to the greatest Side, and the* least *Angle to the least Side, and the* contrary.
4. *Equal Angles are opposite to equal Sides, and the* contrary.
5. *There may be* 3 *right, or* 3 *obtuse Angles.*
6. *If each of the* 3 *Angles be* acute, *each Side will be less than a* Quadrant.
7. *If there are* 2 obtuse *Angles, there must be one Side* greater *than* 90°.
8. *The* 3 *Angles being* equal, *the three Sides will be* equal *(the Triangle being* equilateral) *and the* contrary.
9. *If there be one* acute *Angle, one Side will be* less *than a Quadrant.*
10. *If two Angles be* greater *than* 2 *right Angles, the* Sum *of their opposite Sides will be greater than* 180°; *and therefore, one of them is, at* least, *greater than* 90°.
11. *If the Angles at the Base be of* like Affection, *(both greater or less than* 90°) *the* Perpendicular *falling, from the* vertical Angle, *on the* Base, *will fall* within *the Triangle: but if of* different Affection *will fall without.*
12. *If two Angles be* obtuse, *and one Angle* acute, *the Sides will be of* like *Affection with their opposite Angles.*
13. *When* 2 $\angle$s *are of* $\left\{\begin{matrix}\text{like}\\ \text{diff.}\end{matrix}\right\}$ *Affection, and the Side included be* $\left\{\begin{matrix}\text{more}\\ \text{less}\end{matrix}\right\}$ *than* 90°, *the* 3d $\angle$ *is* $\left\{\begin{matrix}\text{obtuse}\\ \text{acute.}\end{matrix}\right\}$
14. *Two unequal* $\angle$s $\left\{\begin{matrix}\text{less}\\ \text{greater}\end{matrix}\right\}$ *than* 90°, *the Side opposite to the* $\left\{\begin{matrix}\text{less}\\ \text{greater}\end{matrix}\right\}$ *Angle, will be* $\left\{\begin{matrix}\text{less}\\ \text{more}\end{matrix}\right\}$ *than* 90°.
15. *Two equal* $\angle$s *being* $\left\{\begin{matrix}\text{less}\\ \text{more}\end{matrix}\right\}$ *than* 90°, *their opposite Sides will be* $\left\{\begin{matrix}\text{less}\\ \text{more}\end{matrix}\right\}$ *than* 90°.
16. *The* Sum *of any two* $\left\{\begin{matrix}\text{Angles}\\ \text{Sides}\end{matrix}\right\}$ *is* $\left\{\begin{matrix}\text{more}\\ \text{less}\end{matrix}\right\}$ *than the Difference between the* 3d $\left\{\begin{matrix}\text{Angle}\\ \text{Side}\end{matrix}\right\}$ *and* 180°.
17. *The* Sum *of the* 3 $\left\{\begin{matrix}\text{Angles}\\ \text{Sides}\end{matrix}\right\}$ *is less than* $\left\{\begin{matrix}540\\ 360\end{matrix}\right\}$ *and more than* 180°.
18. *The Sum of any two Angles* — 3d *Angle (or any Angle and the Difference of the other* 2 *Angles) is less than* 90°.

Of SIDES.

In ANY Spherical TRIANGLE,

19. ONE *Side being greater than* 90°, *that Triangle has one* obtuse Angle.
20. *If each of the* 3 *Sides be greater than a Quadrant, each of the* 3 *Angles will be* obtuse.
21. *The* Sum *of any two Sides is greater than the* 3d *Side.*
22. *The more Degrees there be in each Side the more will the Sum of the Angles exceed* 180°; *the* Spherical *Triangle then differing the more from a* right-lined *Triangle.*
23. *One of the equal Sides of an* Isosceles Triangle *being* equal *to,* less, *or* greater *than,* 90°, *the Angle at the Base will be also* equal *to,* less, *or* greater *than,* 90°.
24. *Either Side of an* Isosceles Triangle *is of* like Affection *with its* adjacent *or opposite Angle.*
25. *Two Sides being less than a* Quadrant, *there will be an* acute *Angle in that Triangle.*
26. *When* 2 Sides *are of* like *Affection, and the included Angle be* acute, *the third Side will be less than a* Quadrant.
27. *When* 2 Sides *are of* different Affection, *and the included Angle be* obtuse, *the* third *Side will be greater than a* Quadrant.
28. *When the* Sum *of any* 2 *Sides be* equal *to,* less, *or* greater *than, a Semicircle, the Sum of their opposite Angles will be also* equal *to,* less, *or* greater *than a Semicircle.*
29. *When the* Sum *of any two Sides is* equal *to,* less, *or* greater *than, a Semicircle, the internal Angle, included by those Sides, will be* equal *to,* less, *or* greater *than, the* external *opposite Angle, included by one of those Sides, and the* third *Side continued.*
30. *If two Sides be* less, *and one greater than* 90°, *the Angles will be of* like Affection *with their opposite Sides.*
31. *If two Sides are of* $\left\{\begin{matrix}\text{like}\\ \text{diff.}\end{matrix}\right\}$ *Affection, and the* $\angle$ *included be* $\left\{\begin{matrix}\text{acute}\\ \text{obtuse}\end{matrix}\right\}$ *the* 3d *Side will be* $\left\{\begin{matrix}\text{less}\\ \text{greater}\end{matrix}\right\}$ *than* 90°.

AFFECTIONS of *Right-angled Spherical* TRIANGLES.

In a RIGHT-ANGLED Spherical TRIANGLE.

1. EACH *oblique Angle and its oppoſite Leg is of* like Affection.
2. *If one Leg be a Quadrant, the* Hypothenuſe *will be a Quadrant.*
3. *If both* oblique ∠*s, or both* Legs *are of* $\left\{\begin{matrix}\text{like}\\ \text{diff.}\end{matrix}\right\}$ *Affection, the Hypothenuſe is* $\left\{\begin{matrix}\text{leſs}\\ \text{more}\end{matrix}\right\}$ *than* 90°, *and the* contrary.
4. *If the Hypothenuſe is* $\left\{\begin{matrix}\text{leſs}\\ \text{greater}\end{matrix}\right\}$ *than* 90°, *then either Leg is* $\left\{\begin{matrix}\text{like}\\ \text{unlike}\end{matrix}\right\}$ *the adjacent* ∠, *and the* contrary.
5. *If the* Hyp. *and one* Leg *are of* $\left\{\begin{matrix}\text{like}\\ \text{diff.}\end{matrix}\right\}$ *Affection, the other Side and op.* ∠ *are* $\left\{\begin{matrix}\text{leſs}\\ \text{more}\end{matrix}\right\}$ *than* 90°, *and the* contrary.
6. *The* Sum *of the* 2 oblique *Angles is greater than one, and leſs than* 3 *right Angles.*

REMARK. The *doubtful Caſes* ſeldom ariſe in *aſtronomical Computations*, wherein are commonly uſed right-angled Triangles, whoſe Arcs are leſs than 90°: For when there are *greater Arcs* occur, it is uſual for the *Computer* to take their *Supplements*, and work by the *contrary Triangle.*

Quicquid in Aſtronomicis, Geographicis, vel Nauticis, efficiendum, Trigonometriæ attribuendum eſt.

Emerſon's Navigation.

TO ſail *nearly* by the ARCH of a GREAT CIRCLE, when a *given* COURSE *can be purſued.*

STEER, from the Place of your *Departure* to the *Port* you are bound for, all the Way, by the Angle of *Poſition* from your laſt Place arrived in, each Day, at *Noon*; by computing the *Difference* of Latitude and Longitude for each Day's *Reckoning* at Noon, and thence compute each ſucceſſive Angle of Poſition; *by which you are to ſteer from Day to Day.*

To determine the Angle of Poſition from one given Place to another.

RULE. Find the Diſtance of each of two Places from the *ſame Pole.* Then (by *Caſe* 7th oblique *Spherical* Trigonometry) Say,

By PROPORTION.

1. As *Coſ.* $\frac{1}{2}$ *Sum* : *to Coſ.* $\frac{1}{2}$ *Diff. of the Diſtance from the ſame Pole,* :: *ſo Cotan.* $\frac{1}{2}$ *Diff. Long. between the two Places,* : *to Tan. of an Arch* D $\left\{\begin{matrix}\text{leſs}\\ \text{greater}\end{matrix}\right\}$ *than* 90° $\Big\}$ *if* $\frac{1}{2}$ *Sum* Polar *Diſt.* $\left\{\begin{matrix}\text{leſs}\\ \text{greater}\end{matrix}\right\}$ *than* ~~180°~~. 90°
2. As *Sine* $\frac{1}{2}$ *Sum* : *to Sine* $\frac{1}{2}$ *Diff. of the Diſtances from the ſame Pole,* :: *ſo the Cotan.* $\frac{1}{2}$ *Diff. Longitude between the two Places,* : *to Tang.* Arch E *leſs than* 90°.

NOW, $\left.\begin{matrix}D+E\\ D-E\end{matrix}\right\}$ the ∠ of Poſition at the Place of $\left\{\begin{matrix}\textit{greater}\\ \textit{leſs}\end{matrix}\right\}$ Latitude $\left\{\begin{matrix}\textit{neareſt to}\\ \textit{furtheſt from}\end{matrix}\right\}$ the *ſame* Pole.

Some PROPERTIES of *Sines, Tangents,* &c.

IF $1 =$ Rad. $t =$ Tan. $\sigma =$ Coſec.
$s =$ Sine $\tau =$ Cotan. $v =$ ver. Sine
$c =$ Coſ. $ſ =$ Secant $V =$ verſ. S. Sup.
$1-s =$ Cover. S. } of any Arc.

Then, 1. $s = \sqrt{1-cc} = ct = \frac{t}{ſ} = \frac{t}{\sqrt{1+tt}} = \frac{c}{\tau} = \frac{1}{\sigma} = \sqrt{Vv}.$

2. $c = r - v = V - 1 = \sqrt{1-ss} = \frac{s}{t} = \frac{1}{ſ} = \frac{\tau}{\sigma} = \frac{\tau}{\sqrt{1+\tau\tau}}.$

3. $t = sſ, = \frac{s}{c} = \frac{s}{\sqrt{1-ss}} = \frac{1}{\tau} = \frac{1}{\sqrt{\sigma^2-1}} = \frac{s\sigma}{\tau} = \frac{ſ}{\sigma}.$

4. $\tau = \sqrt{\sigma\sigma-1} = \frac{1}{t} = \frac{s\sigma}{t} = \frac{cſ}{t} = \frac{c}{s} = \frac{c}{\sqrt{1-cc}}.$

5. $ſ = t\sigma = \sqrt{1+tt} = \frac{1}{c} = \frac{t}{s} = \frac{\sigma}{\tau} = \frac{1}{\sqrt{1-ss}} = \frac{1}{1-v} = \frac{1}{V-1}.$

6. $\sigma = \sqrt{1+\tau\tau} = \frac{1}{s} = \frac{ſ}{t} = \frac{t}{c} = \frac{1}{ct} = \frac{1}{\sqrt{1-cc}} = \frac{ſ}{\sqrt{ſſ-1}} = \frac{1}{\sqrt{2v-vv}}.$

7. $v = 2 - V = 1 - c = 1 - \sqrt{1-ss} = 1 - \frac{1}{\sqrt{1+tt}}.$

8. $V = 2 - v = 1 + \sqrt{1-ss} = 1 + c = 1 + \frac{1}{\sqrt{1+tt}} = \frac{s+t}{t} = 1 + s\tau = 1 + \frac{1}{ſ} = \frac{\tau+\sigma}{\sigma}.$

9. $1 = ss + cc = ſſ - tt = \sigma\sigma - \tau\tau = t\tau = cſ = s\sigma.$

Or, If $r =$ Log. Rad. $= 1$, $s =$ Log. Sine of an Arc, $c =$ Log. Coſ. } $t =$ Log. Tan., $\tau =$ Log. Cot. } $ſ =$ Log. Sec., $\sigma =$ Log. Coſec.

Then, $s = c + t - r = t + r - ſ = c + r - \tau = 2r - \sigma.$
$c = s + r - t = 2r - ſ = s + \tau - r = \tau + r - \sigma.$
$t = s + r - c = 2r - \tau.$
$\tau = c + r - s = 2r - t.$
$ſ = t + r - s = 3r - s - \tau = \sigma + r - \tau = 2r - c.$
$\sigma = \tau + r - c = 3r - c - t = ſ + r - t = 2r - s.$

If the natural Sines of two different Arcs be denoted by S *and* s, *and their natural Coſines by* C *and* c, *Radius being Unity.*

Sine of their *Sum* $= Sc + sC$
Sine of their *Diff.* $= Sc - sC$
Coſine of their *Sum* $= Cc - Ss$
Coſine of their *Diff.* $= Cc + Ss$ } Make $S = s$, and $C = c$.

Hence, the Sine of *twice* an Arc, or of 2 equal Arcs $= 2\,CS$.
And *Coſine* of a *double* Arc $= C^2$ Dif. S^2.

Alſo, if S and C = Sine and Coſine of $\frac{1}{2}$ *Sum* of 2 Arcs,
And s, c = Sine and Coſine of $\frac{1}{2}$ their Difference,
Then, $Sc + Cs$ = Sine greater, $Sc - Cs$ = Sine leſs,
And $Cc - Ss$ = Coſine greater, $Cc + Ss$ = Coſine leſs.

Again, If T and t denote the Tangents of two diff. Arcs, Rad. = 1.

Then, $\frac{T+t}{1-tT} =$ Tan. Sum; and $\frac{T-t}{1+tT} =$ Tan. Diff. But,

for *Tangent, Secant, Coſine,* and *Cotangent* of an Arc above 90° take for an Arc as much below 90°, writing a *negative* Sign.

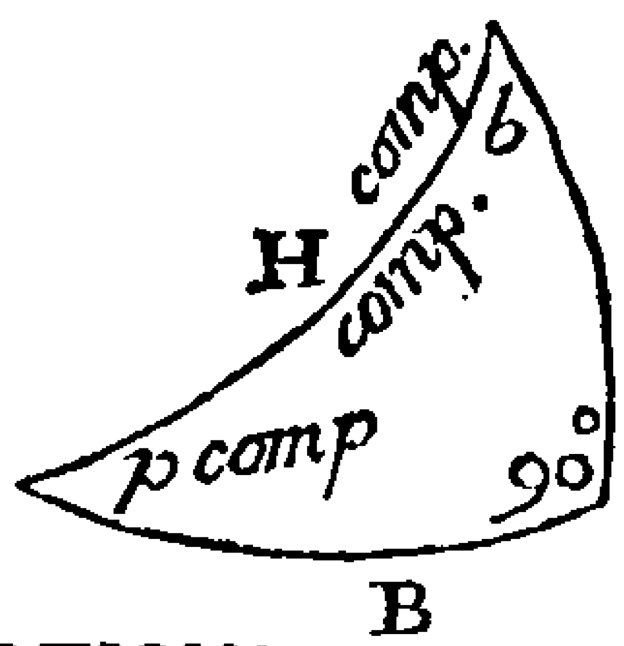
As Sum of Tangents of 2 ∠*s* : *to their Diff.* :: *ſo Sine of the Sum of thoſe* ∠*s* : *to Sine of their Difference.*

For infinite other Properties, and Proportions of Arches, Sines, Tangents, &c. conſult Mr. *Emerſon's Trigonometry.*

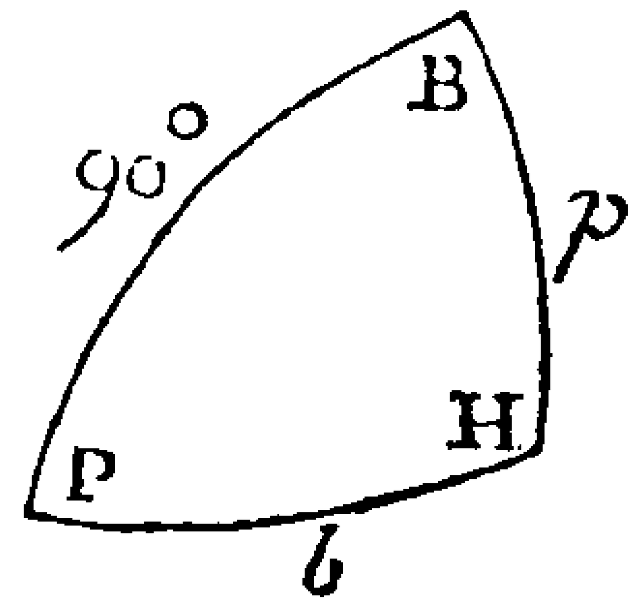
ANSWERS

ANSWERS to all the CASES of RIGHT-ANGLED *Spherical* TRIANGLES.

IN a RIGHT-ANGLED spherical TRIANGLE, *If* H *represent the* Hypothenuse, *or Side opposite to the Right-Angle,* B, *and* P, *the other Sides,* Base *and* Perpendicular, *or* LEGS; b *and* p *their opposite Angles; then any two of these* 5 Terms *being given the* Rest *are found by the* ANSWERS *to the* CASES *in the following* TABLE.



OR, *changing the* SIDES *of a Right-angled* Spherical TRIANGLE, *to* ANGLES, *and the* ANGLES *to* SIDES, *as in the* annexed *Figure, the* Cases *and their* ANSWERS, *are as in the following* TABLE.



N. B. In the PROPORTIONS, r represents *Radius*; s *Sine*; s' *Cosine*; t *Tangent*; t' *Cotangent*; {—, *less* / +, *more*} than 90°; because *Arcs* and their *Supplements* have the same *Sines, Cosines, Tangents,* and *Cotangents.*

☞ But here, instead of H, you must take its *Supplement.* And, for *like,* put *unlike,* and the *contrary,* where a *Side* or *Angle* is determined from the *Species* of H; or where H, in Species, is *to be found.*

Case.	Given.	Reqd.	ANSWER. By PROPORTION. in *Symbols.*	Given.	Required.	ANSWER. By PROPORTION. in *Words.*
1	H.p	B	r : s'.p :: t.H : t.B $\mp$, If H {*like* / *unlike*} p.	*Hypoth. and* ∠.	*Leg adjacent.*	Rad. : Cos. given ∠ :: Tan. Hyp. : Tan. Leg adj.
2		P	r : s.H :: s.p : s.P, *like* p.		*Leg opposite.*	Rad. : Sine Hyp. :: Sine given ∠ : Sine op. Leg.
3	I.	b	r : s'.H :: t.p : t'.b $\mp$, If H {*like* / *unlike*} p.		*Other* ∠.	Rad. : Cos. Hyp. :: Tan. given ∠ : Cot. other ∠.
4	H.B	p	r : t'.H :: t.B : s'.p $\mp$, If H {*like* / *unlike*} B.	*Hypoth. and one Leg.*	*Adjacent* ∠.	Rad. : Cot. Hyp. :: Tan. given Leg. : Cos. ∠ adj.
5		b	s.H : r :: s.B : s.b, *like* B.		*Opposite* ∠.	Sine Hyp. : Rad. :: Sine giv. Leg : Sine opp. ∠.
6	II.	P	s'.B : r :: s'.H : s'.p $\mp$, If H {*like* / *unlike*} B.		*Other Leg.*	Cos. Leg giv. : Cos. Hyp. :: Rad. : Cos. other Leg.
7	B.p	H	s'.p : r :: t.B : t.H $\mp$, If B {*like* / *unlike*} p.	*Leg and* ∠ *adjacent.*	*Hypothenuse.*	Cos. giv. ∠ : Rad. :: Tan. adj. Leg : Tan. Hyp.
8		b	r : s.p :: s'.B : s'.b, *like* B.		∠ *opposite.*	Rad. : Sine adj. ∠ :: Cos. adj. Leg : Cos. op. ∠.
9	III.	P	r : s.B :: t.p : t.P, *like* p.		*Leg opposite.*	Rad. : Sine giv. Leg :: Tan. adj. ∠ : Tan. op. Leg
10	B.b	H	s.b : r :: s.B : s.H $\mp$ *both true.*	*Leg and* ∠ *opposite.*	*Hypothenuse.*	Sine opp. ∠ : Rad. :: Sine giv. Leg : Sine Hyp.
11		P	r : t.B :: t'.b : s.P $\mp$ *both true.*		*Other Leg.*	Rad. : Tan. giv. Leg :: Cot op. ∠ : Sine other Leg.
12	IV.	p	s'.B : r :: s'.b : s.p $\mp$ *both true.*		∠ *adjacent.*	Cos. giv. Leg : Rad. :: Cos. op. ∠ : Sine ∠ adj.
13	B.P	H	r : s'.B :: s'.P : s'.H $\mp$, If B {*like* / *unlike*} P.	*Legs.*	*Hypothenuse.*	Rad : Cos. one Leg :: Cos. other Leg : Cos. Hyp.
14		p	s.B : r :: t.P : t.p, *like* P.		∠ *opp.* 1 *Leg.*	Sine one Leg : Rad. :: Tan. other Leg : Tan. op. [∠.
..	V.	b	s.P : r :: t.B : t.b, *like* B.		∠ *opp. other* [*Leg.*	. . . .
15	b.p	H	t.b : t'.p :: r : s'.H $\mp$, If b {*like* / *unlike*} p.	∠*s.*	*Hypothenuse.*	Tan. one ∠ : Cot. other ∠ :: Rad. : Cos. Hyp.
16		B	s.p : r :: s'.b : s'.B, *like* b.		*One Leg.*	Sine one ∠ : Rad. :: Cos. other ∠ : Cos. op. Leg.
..	VI.	P	s.b : r :: s'.p : s'.P, *like* p.		*Other Leg.*	. . . .

UNIVERSAL PROPOSITION. *In any right-angled spherical Triangle, the Sine of the* middle Part *and* Radius *are reciprocally proportional to the Tangents of the* Extremes conjunct, *and to the Cosines of the* Extremes disjunct.

Viz. Rad. × Sine *middle Part* = {Rectangle Tangents of *Extremes conjunct.* / Rectangle Cosines of *Extremes disjunct.*} One of the 5 *Parts* of a right-angled Triangle (omitting *Radius*) being reckoned *middle Part*; and the *two* contiguous or remote Parts, *Extremes conjunct,* and *disjunct.*

☞ *The* Hypothenuse, *and* two *adjacent Angles, are considered, in the above Proportions, as* Complements *of their real Arcs.*

One Term	*Hyp. or* ∠	*Leg*
Middle Part	*Cosine*	*Sine*
Extr. conjunct	*Cotangent*	*Tangent*
Extr. disjunct	*Sine*	*Cosine*

Like RATIOS in the same RECTANGLE.

Radius : *Sine* : *Cosine*
Secant : *Tangent* : *Radius*
Cosecant : *Radius* : *Cotangent.*

EXAMPLE I. *If* B *and* p *are given to find* P? Here (among the 5 Parts, B, p, H, b, P) Sine B is *middle Part,* and Cotang. p, and Tang. P, *Extremes conjunct*; that is s.B × r = t'.p × t.P. Hence, t'.p : r :: s.B : t.P; Or, r : t'.p :: s.B : t.P. That is, (Putting r : t for t' : r.) r : s.B :: t.p : t.P.

EXAMPLE II. *If* P *and* b *are given to find* p? Here s'.p is Middle Part, and s.b and s'.P Extremes disjunct. *Therefore,* s'.p × r = s.b × s'.P; Whence, r : s.b :: s'.P : s'.p.

☞ *In a right-angled spherical Triangle, if the* Legs *(and therefore the* ∠*s)* {*be* like / unlike} Then the *Hypothenuse* {— / +} than 90°, and *contra.*

vide note 331

ANSWERS to all the CASES of OBLIQUE *Spherical* TRIANGLES.

IN any *oblique* angled *spherical* TRIANGLE, ABC, whose *Sides*,
BC = A, CA = B, BA = C, and *op.* ∠s = a, = b, = c.
Any 3 *of which* 6 *Terms being given, the Rest are found as* below.

Fig. 1.

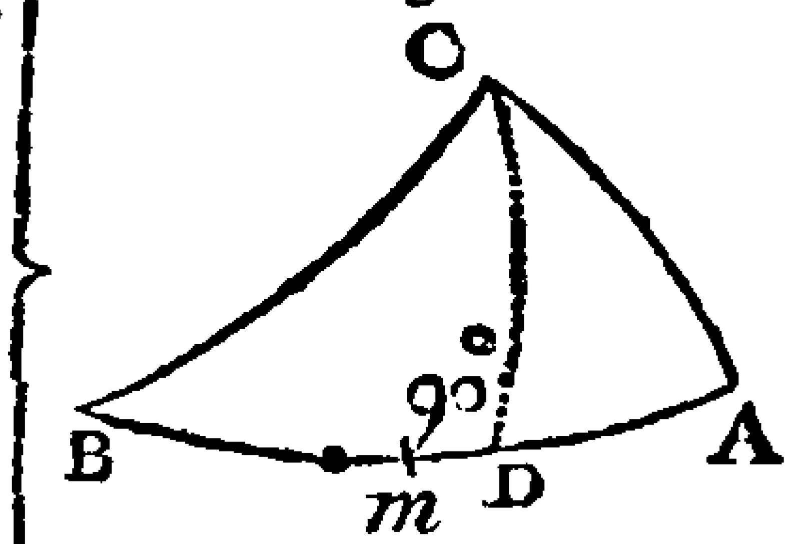


Fig. 2.

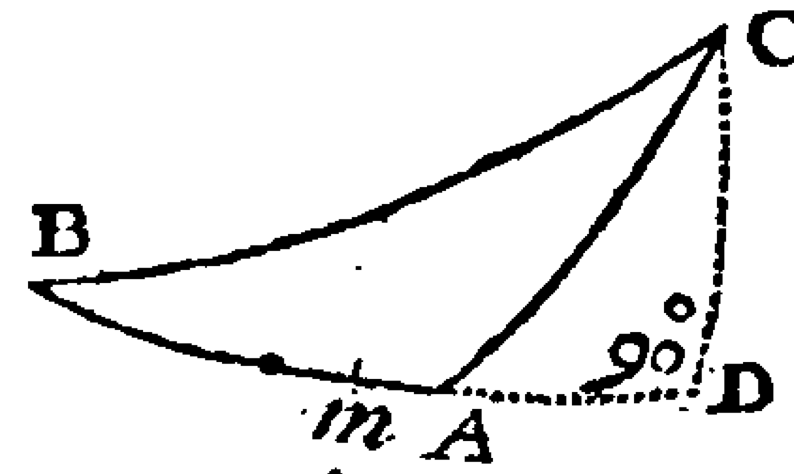


Fig. 3.

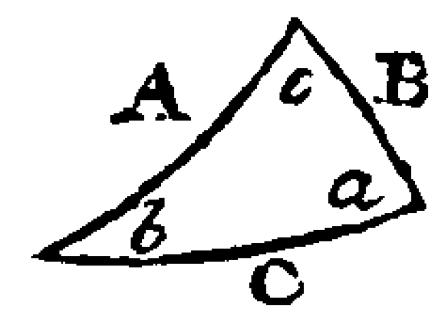
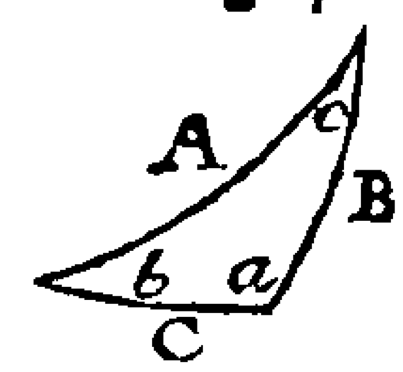


Fig. 4.



Let r = *Radius*, s = *Sine*, s' = *Cosine*, t = *Tangent*, t' = *Cotangent*.

$<$ *less*, $>$ *greater* than. — *less*, + *more* than 90°. $d = \angle BCD$; $e = \angle ACD$. $D = BD$; $E = AD$.

Cases.	Given.	Sought.	ANSWER. By PROPORTION. in *Symbols*.	GIVEN.	SOUGHT.	ANSWER. By PROPORTION. in *Words*.
1	A, B, *b*	*a*	$s.B : s.b :: s.A : s.a \mp$ *both true, or ambiguous.*	2 *Legs* ∠ *opposite one of them.*	*Other* op. ∠.	Sine 1 Leg : S. its op. ∠ :: S. oth. Leg : S. op. ∠.
2	. . .	*c*	$r : s'.A :: t.b : t'.d$ like/unlike A, if b −/+ ; $t.B : t.A :: s'.d : s'.c$ like/unlike B, if b −/+ ; Then $c = d \pm e$, *both true.*		Included ∠.	Rad. : Cos. Leg adj. to ∠ :: Tan. ∠ given : Cot. vert. ∠ included by adj. Leg and Perp. Tan. op. Leg : Tan. adj. Leg :: Cos. adj. vert. ∠ : Cos. oth. ver. ∠ incl. by oth. Leg. & Perp. *Then*, ∠ required = *Sum* ~~and~~ *Dif.* vert. ∠.
3	. . .	C	$r : s'.b :: t.A : t.D$ like/unlike A, if b −/+ ; $s'.A : s'.B :: s'.D : s'.E$ like/unlike B, if b −/+ ; Then C = D ± E, both true. But, if B = A, or = 180° − A, or be betw. A & 180° − A, then *a like* A only. And If A like/unlike *b*, then $c = d \pm e$ only; And C = D ± E only.	. . . .	Base.	Rad. : Cos. ∠ given :: *Tan.* adj. Leg. : *Tan.* adj. Segment of Base. Cos. adj. Leg : *Cos.* other Leg :: *Cos.* adj. Segment : Cos. other Segment. Then *Base* reqd. = *Sum* or *Dif.* of Segments.
	I.					
4	*a*, *b*, A	B	$s.a : s.A :: s.b : s.B \mp$, both true.	2 ∠s *at Base and Leg opposite one of them.*	Other Leg.	Sine op. ∠ : S. Leg given :: S. oth. ∠ : S. op. Side.
5	. . .	C	$r : s'.b :: t.A : t.D$ like/unlike *b* if A −/+ ; $t.a : t.b :: s.D : s.E \mp$, both true. Then C = D ± E, if *a* like/unlike *b*.		*Base.*	Radius : Cos. ∠ adj. to Leg :: Tan. Leg : Tan. adjacent Segment of Base. *Tan.* op. ∠ to Leg : Tan. adj. ∠ :: Sine adj. Segment : Sine other Segment. *Then*, Base reqd = *Sum* or *Dif.* Segments.
6	. . .	*c*	$r : s'.A :: t.b : t'.d$ like/unlike *b*, if A −/+ ; $s'.b : s'.a :: s.d : s.e \mp$, *both true.* Then, $c = d \pm e$ if *a* like/unlike *b*. But, if A = B, or 180° − B, or is between B and 180° − B, then B *unlike b*; and E + *e are impossible.*	. . . .	*Third* ∠.	*Rad.* : Cos. Leg given :: *Tan.* adj. ∠ : Cot. adjacent vertical ∠ by Leg and Perp. *Cos.* adj. ∠ : Cos. ∠ op. to Leg :: Sine adj. vert. ∠ : Sine other vertical ∠. *Then*, reqd ∠ = *Sum* or *Dif.* vert. ∠s.
	A. B. & *a*. *b*.	C	$s.\frac{1}{2}\overline{a-b} : s.\frac{1}{2}\overline{a+b} :: t.\frac{1}{2}\overline{A-B} : t.\frac{1}{2}C.$	2 *Sides and* 2 *opp.* ∠*s.*	Third Side.	Sine ½ Dif. op. ∠s : Sine ½ their Sum :: Tan. ½ Dif. Legs : Tan. ½ *third* Side.
		c	$s.\frac{1}{2}\overline{A-B} : s.\frac{1}{2}\overline{A+B} :: t.\frac{1}{2}\overline{a-b} : t'.\frac{1}{2}c.$		Third ∠.	Sine ½ Dif. Legs : Sine ½ their Sum :: Tan. ½ Dif. op. ∠s : Cot. ½ *third* ∠.
	II.					
7	A, C, *b*	*a*	$r : s'.b :: t.A : t.D$ like/unlike A if C −/+ ; E = C Dif. D. $s.E : s.D :: t.b : t.a$ like/unlike *b*, if D < / > C.	2 *Sides and included* ∠.	*Other* ∠s.	Rad. : Cos. included ∠ :: Tan. Side op. reqd. ∠ : Tan. adjacent Segm. Base. The other Seg. Base = Dif. Base and adj. Seg. *Sine* latter Segm. : Sine former found Segm. :: Tan. ∠ included : Tan. sought ∠.
		Or	$s.\frac{1}{2}\overline{A+C} : s.\frac{1}{2}\overline{A-C} :: t'.\frac{1}{2}b : t.E -$		Or	Sine ½ Sum Sides : Sine ½ their Dif. :: Cot. ½ incl. ∠ : Tan. remote Segment Base.
		Again	$s'.\frac{1}{2}\overline{A+C} : s'.\frac{1}{2}\overline{A-C} :: t'.\frac{1}{2}b : t.D \mp$ If A + C < / > 180°. Then, a = D + E. And c = D − E.		Again	*Cos.* ½ *Sum* Sides : Cos. ½ their *Dif.* : Cot. ½ incl. ∠ : Tan. adjacent Segment of Base. *Then*, other ∠ at Base = *Sum*, ∠ at Vertex = *Dif.* Base's Segments.
8	. . .	B	$r : s'.b :: t.A : t.D$ like/unlike A, if *b* −/+ ; E = C Dif. D. $s'.D : s'.E :: s'.A : s'.B$ like/unlike E, if *b* −/+	. . . .	Third Side.	Rad. : Cos. included ∠ :: Tan. of either Side : Tan. of adjacent Segment of Base. Whence other Seg. = Dif. Base and that Seg. *Cos.* adj. Seg. : Cos. remote Seg. of Base :: Cos. adj. Side : Cos. remote Side.
	III.					

vide note 331

ANSWERS

ANSWERS to the CASES of OBLIQUE *Spherical* TRIANGLES continued.

Cases.	Given.	Sought.	ANSWER. By PROPORTION. } In *Symbols*.	GIVEN.	SOUGHT.	ANSWER. By PROPORTION. } In *Words*.
9	b, c, A	a	$r : s'.A :: t.b : t'.d$ *like* / *unlike* } b, if A { − / +	2 ∠s and *included Side*.	*Third* ∠.	Rad. : Cos. included Side :: Tan. adj. ∠ at Base : Cot. adj. vert. ∠.
			$e = c$ Dif. d, Then			Whence the remote vert. ∠ is known = Dif. whole vert. ∠ and adj. vertical ∠.
			$s.d : s.e :: s'.b : s'.a$ *like* / *unlike* } b, if d { < / > c.			Sine adj. : Sine remote vert. ∠ :: Cos. adj. ∠ at Base : Cos. required ∠.
10	. . .	B	$r : s'.A :: t.b : t'.d$ *like* / *unlike* } b, if A { − / +	. . . .	Sides.	Rad. : Cos. included Side :: Tan. adj. ∠ at Base : Cot. adj. vertical ∠.
			$e = c$ *Dif.* d.			Hence remote vertical ∠ = Difference whole and adjacent vertical ∠.
			$s'.c : s'.d :: t.A : t.B$ *like* / *unlike* } c, if b { − / +			Cos. remote ∠ : Cos. adj. vert. ∠ :: Tan. adj. vert. ∠ : Tan. Side required.
		Or,	$s.\frac{1}{2}\overline{b+c} : s.\frac{1}{2}\overline{b-c} :: t.\frac{1}{2}A : t.E-$		Or,	Sine ½ Sum ∠s : Sine ½ Diff. :: Tan. ½ adj. Side : Tan. remote Segment.
		And,	$s'.\frac{1}{2}\overline{b+c} : s'.\frac{1}{2}\overline{b-c} :: t.\frac{1}{2}A : t.D \mp$ if $\overline{b+c}$ < / > 180°.			Cos. ½ Sum : Cos. ½ Dif. ∠s :: Tan. ½ adj. Side : Tan. adj. Segment at Base.
	IV.		Then, B = D + E ; C = D − E.			Then required Sides = Sum and Difference of Segments at Base.
11	A, B, C	b	$t.\frac{1}{2}C : t.\frac{1}{2}\overline{A+B} :: t.\frac{1}{2}\overline{A-B} : t.mD =$ Dist. *Perpend.* from *Middle* of the Base.	3 *Sides*.	∠ at the Base.	Tan. ½ Base : Tan. ½ Sum Legs :: Tan. ½ Dif. Legs : Tan. ½ Dif. or ½ Sum Segments of Base.
			Now, if Perp. within, $Bm + mD = BD$ } *greater* / *less* } Segm. $Am - mD = DA$ Or $2 \times mD = BD$, when Perp. without.			Now, if Perpendicular falls within, ½ Base { add / subt } ½ Dif. for { greater / less } Segm. Or ½ Sum doubd = wh. Base; the Perp. without.
		Now,	$t.A$: Rad. :: $t.BD$: Cos. b. *Case* 4. *Right angled* △s.		Now,	*Tan* Leg adj. ∠ required : Rad. :: *Tan.* adj. Segment : Cos. ∠ adj. required.
		Or,	$s.C \times s.A$ (including ∠ required) : $r^2 :: s.\frac{1}{2}\overline{B+C-A} \times s.\frac{1}{2}\overline{B+A-C} : s^2.\frac{1}{2}b$. if A + B { < / > } 180°, the Perpend. falls nearest the { *less* / *greater* } Side.		Or,	*Rect.* ∠ Sines Sides (including required ∠) : Rad. Sq. :: *Rect.* ∠ Sines, of two Differences betw. ½ Sum of 3 Sides, and each Side including the required ∠ : Square of Sine ½ *required* ∠.
	V.					
12	a, b, c	A	As ∠s at *Base* are *like* / *unlike* } Perp. falls { within. / without.	3 ∠s.	Side.	Cotan. ½ *Sum* ∠s at Base : Tan. ½ their Dif. :: Tan. ½ vert. ∠ : Tan. ∠ included by Perpendicular and bisecting Arch of the vertical Angle.
			$t'.\frac{1}{2}\overline{a+b} : t.\frac{1}{2}a$ Dif. $b :: t.\frac{1}{2}c : t.$ ∠ included by *Perpendicular* and *Arch* bisecting the vertical ∠. Whence ∠ BCD is known.			
			For, ½ c + *angular* Distance from Perpendicular = *greater* ∠.			Then to ½ vertical ∠ add *angular* Distance from Perpendicular for *greater* ∠.
			½ c, *Diff.* angular Distance from Perpendicular = *less* ∠.			And. *Diff.* between ½ vertical ∠ and angular Distance from Perpendicular = *less* ∠.
			If $a + b$ } < / > { 180°, the Perpend. falls nearest { less / greater } Side { greater / less } ∠.			
		Now,	$t.d : t'.b :: r : s'.A$. *15th Case Right-angled* △s.			Tan adj. vert. ∠ : Cot. adj. ∠ at Base :: Rad. : Cos. adj. Side, being Hypothenuse.
		Or,	$s.b \times s.c : r^2 :: s.\frac{1}{2}\overline{a+c+b} \times s.\frac{1}{2}\overline{c+b-a} : s^2.\frac{1}{2}A$. ☞ *Always let fall your Perpendicular from the End of a given* Side, *and opposite to a given* ∠. Or, change the 3 given ∠s into Sides, and Sides required into ∠s, but instead of the greatest ∠, take its Supplement for one Side, then proceed as in *Case* 11.		Or,	Rect. ∠ Sines of the ∠s, including Side required : Rad Square :: Rect. ∠ two Cosines, of ½ *Sum* of the 3 ∠s, and of ½ *Dif.* between the two including ∠s, and third ∠ : Sine *Square* of ½ included Side, *required*.
	VI.					

The 7th and 8th CASES *reprinted correctly*. *See them on the Left*.

Cases.	Given.	Sought.	In Symbols.	GIVEN.	SOUGHT.	In Words.
7	A, C, b	a	$r : s'.b :: t.A : t.D$ *like* / *unlike* } A { if b { − / +	2 *Sides and included* ∠.	*Other* ∠s.	Rad. : Cos. included ∠ :: Tan. Side op. reqd. ∠ : Tan. adjacent Segm. Base.
			E = C Dif. D.			The other Seg. Base = Dif. Base and adj. Seg.
			$s.E : s.D :: t.b : t.a$ *like* / *unlike* } b, if D } < / > C.			*Sine* latter Segm. : Sine former found Segm. :: Tan. ∠ included : Tan. sought ∠.
		Or	$s.\frac{1}{2}\overline{A+C} : s.\frac{1}{2}\overline{A-C} :: t'.\frac{1}{2}b : t.E-$		Or	Sine ½ Sum Sides : Sine ½ their Dif. :: Cot. ½ incl. ∠ : Tan. remote Segment Base.
		Again	$s'.\frac{1}{2}\overline{A+C} : s'.\frac{1}{2}\overline{A-C} :: t'.\frac{1}{2}b : t.D \mp$		Again	*Cos.* ½ *Sum* Sides : Cos. ½ their *Dif.* : Cot. ½ incl. ∠ : Tan. adjacent Segment of Base.
			If A + C } < / > 180°. Then, a = D + E. And c = D − E.			*Then*, other ∠ at Base = *Sum* } Base's ∠ at Vertex = *Dif.* } Segments.
8	. . .	B	$r : s'.b :: t.A : t.D$ *like* / *unlike* } A, if b } − / +	. . . .	Third Side.	Rad. : Cos. included ∠ :: Tan. of either Side : Tan. of adjacent Segment of Base.
			E = C Dif. D.			Whence other Seg. = Dif. Base and that Seg.
	III.		$s'.D : s'.E :: s'.A : s'.B$ *like* / *unlike* } E, if b } − / +			*Cos.* adj. Seg. : Cos. remote Seg. of Base, :: Cos. adj. Side : Cos. remote Side.

The PROPERTIES of *Spherical* TRIANGLES.

1. IN any ſpherical Triangle, The *Sines of the Sides are in Proportion to the Sines of the oppoſite Angles.*

2. Letting fall a Perpendicular on the Baſe, from the vertical Angle, *The Sines of the Segments of the Baſe are reciprocally proportional to the Tangents of the adjacent Angles.*

3. *The Coſines of the ſame Segments are directly proportional to the Coſines of the adjacent Sides.*

4. *The Coſines of the vertical Angles are as the Cotangents of the reſpective Sides.*

5. *The Sines of the vertical Angles are as the Coſines of the reſpective Angles at the Baſe.*

6. As the Sine of Sum of the Legs : to Sine of their Difference :: ſo Cotangent $\frac{1}{2}$ Sum of Angles at Vertex : to Tangent $\frac{1}{2}$ their Difference.

7. As Sine Sum of the Sides : to Sine of their Difference :: ſo Cotangent $\frac{1}{2}$ vertical Angle : to Tangent $\frac{1}{2}$ Difference, or $\frac{1}{2}$ Sum, of the vertical Angles, according as the Perpendicular falls within or without.

8. As Tangent $\frac{1}{2}$ Sum of Sides : to Tangent $\frac{1}{2}$ their Difference :: ſo Tangent $\frac{1}{2}$ Sum of the Angles at the Baſe, : to Tangent $\frac{1}{2}$ their Difference.

9. As Cotan. of $\frac{1}{2}$ Sum of 2 Sides : to Tan. $\frac{1}{2}$ their Difference :: ſo Cotan. $\frac{1}{2}$ Baſe : to Tan. Diſtance from middle Baſe to where the Perpendicular falls; being Tan. $\frac{1}{2}$ Difference of Segments of Baſe.

10. As Cotangent $\frac{1}{2}$ Sum Angles at the Baſe, : to Tangent $\frac{1}{2}$ their Difference :: ſo Tangent $\frac{1}{2}$ vertical Angle, or $\frac{1}{2}$ Sum vertical Angles, : to Tangent $\frac{1}{2}$ the Difference, or $\frac{1}{2}$ the Sum of vertical Angles, as the Perpendicular falls within or without.

11. As Tangent $\frac{1}{2}$ Sum Segments of the Baſe : to Tangent $\frac{1}{2}$ Sum Sides, :: ſo Tangent $\frac{1}{2}$ Difference of Sides : to Tangent $\frac{1}{2}$ Difference Segments of Baſe.

12. As Tangent $\frac{1}{2}$ Baſe : to Tangent $\frac{1}{2}$ Sum Sides, :: ſo Tangent $\frac{1}{2}$ Diff. Sides : to Tangent $\frac{1}{2}$ alternate Baſe $=$ $\frac{1}{2}$ Difference or $\frac{1}{2}$ Sum Segments of the Baſe, as the Perpendicular falls within or without.

☞ In a right-angled Triangle, the Rectangle of Tangent $\frac{1}{2}$ the Hypothenuſe $+$ $\frac{1}{2}$ one Leg, and the Tangent $\frac{1}{2}$ the Hypothenuſe — $\frac{1}{2}$ that Leg $=$ Tangent Square of $\frac{1}{2}$ the other Leg.

13. Letting fall a Perpendicular on the Baſe of a ſpherical Triangle.

As *Sine Sum Angles at the Baſe : to Sine Difference :: ſo Tangent $\frac{1}{2}$ Sum of the Segments of the Baſe : to Tangent $\frac{1}{2}$ Difference.*

14. *Sine Sum Angles at the Baſe : Sine Difference :: ſo Tangent $\frac{1}{2}$ Baſe : to Tangent $\frac{1}{2}$* alternate *Baſe.*

15. *Sine Sum Segments of the Baſe : to Sine of their Difference :: ſo Sine Sum Angles at the Vertex : to Sine of their Difference.*

16. As *Sine Baſe : to Sine vertical Angle :: ſo Sine Diff. Segments at Baſe : to Sine Diff. of Angles at Vertex, when the Perpendicular falls within; or Sine of the Sum of Segments of Baſe : to Sine Sum of vertical Angles, when the Perpendicular falls without.*

17. As *Coſine $\frac{1}{2}$ Sum of the Sides : to Coſine $\frac{1}{2}$ their Difference :: ſo Cotangent $\frac{1}{2}$ included Angle : to Tangent $\frac{1}{2}$ Sum of oppoſite Angles.*

18. As *Sine $\frac{1}{2}$ Sum of the Sides : to Sine $\frac{1}{2}$ their Difference :: ſo Cotangent $\frac{1}{2}$ included Angle : to Tangent $\frac{1}{2}$ Difference of oppoſite Angles.*

19. As *Coſine $\frac{1}{2}$ Sum of 2 Angles : to Coſine $\frac{1}{2}$ their Difference :: ſo Tangent $\frac{1}{2}$ included Side : to Tangent $\frac{1}{2}$ Sum of the oppoſite Sides.*

20. *Sine $\frac{1}{2}$ Sum of two Angles : to Sine $\frac{1}{2}$ their Difference :: ſo Tangent $\frac{1}{2}$ included Side : to Tangent $\frac{1}{2}$ Difference of oppoſite Sides.*

21. *Coſine $\frac{1}{2}$ Sum Angles at the Baſe : to Coſine $\frac{1}{2}$ their Difference :: ſo Tangent $\frac{1}{2}$ Difference of oppoſite Sides : to Tangent $\frac{1}{2}$ Difference or $\frac{1}{2}$ Sum, of the Segments of the Baſe, as the Perpendicular falls within or without.*

22. In any ſpheric Triangle, The *Rectangle of the Sines of any two Sides, $\times$ Coſine of included Angle, $+$* Rectangle *of their Coſines $=$ Coſine of third Side.* (Radius being 1.)

23. *The Coſine of an Angle of a ſpherical Triangle, $=$ Coſine oppoſite Side — Rectangle of Coſines of the including Sides, the whole divided by the Rectangle of the Sines of the including Sides.* (Radius being 1.)

24. *The Rectangle of Sines of 2 Angles $\times$ Coſine of the included Side — Rectangle of their Coſines $=$ Coſine of third Angle,* Radius being 1.

25. *The Coſine of any Side $=$ Rectangle of the Coſines of the including Angles $+$ Coſine of oppoſite Angle, and the whole divided by Rectangle of Sines of the including Angles,* Radius $=$ 1.

26. In any ſpherical Triangle, As *the Product of the Sines of two Sides, including a required Angle, : to the Product of the Sines of two Differences between the $\frac{1}{2}$ Sum of the 3 Sides, and each of the two Sides, including the required Angle, :: ſo the Square of Radius : to the Square of the Sine of $\frac{1}{2}$ the required Angle.*

27. As *the Product of the Sines of two Angles, including a required Side, : to the Product of the Sines of two* Differences, *between the half* Supplement *of the three given Angles, and the Supplement of each Angle, including the required Side, :: ſo the Square of the Radius : to the Square of the Coſine of $\frac{1}{2}$ the required Side.*

Or, taking the Supplement of the greateſt Angle only, you may proportion, as by Property 26, by changing the Sides into Angles.

Viz. *As the Product of the Sines of two Angles, including the required Side, : to the Product of the Sines of two Differences between the $\frac{1}{2}$ Sum of the 3 given Angles (the Supplement of the greateſt being one) and each of the Angles, including the required Side, :: ſo is the Square of Radius, : to Square of the Sine of $\frac{1}{2}$ required Side.*

REMARK. In *plane Trigonometry,* right-angled Triangles may be conſidered as ſpherical Triangles, whoſe Sides being very ſmall Arcs may be conſidered as Right-Lines; and therefore become equal to their *Sines* or *Tangents.*

HENCE,

The PROPERTIES of *Spherical* TRIANGLES.

HENCE, to *plane Trigonometry*, may be applied, all the Proportions of *spherical Trigonometry*, wherein *Cosines* and *Cotangents* are not concerned, by using the Word *Side*, instead of *Sine of a Side*, or *Tangent of a Side*. For, if the 3 Sides of a plane Triangle were given, an Angle may be found, as follows, by Property 26.

As the Product of 2 Sides, including a required Angle, : to the Product of two Differences, between $\frac{1}{2}$ Sum of the three Sides, and each of the Sides including the required Angle, :: so the Square of Radius : to the Square of the Sine of $\frac{1}{2}$ required Angle.

28. In any spherical Triangle, As *Rectangle of Sines of 2 Sides, including a required Angle, : to Radius Square :: so versed Sine Base — versed Sine Difference of Sides, : to versed Sine included Angle,* required.
:: And *so Cosine Difference of Sides — Cos. Base : to versed Sine said included Angle,* required.

29. Also, As *Rectangle of the Sines of 2 Angles, including a required Side, : to Radius Square, :: so versed Sine Sum of including Angles,— versed Sine Supplem. 3d Angle : to versed Sine included Side,* required.
:: And *so versed Sine third Angle — versed Sine Supplem.* Sum *of including Angles, : to versed Sine included Side,* req^{d}.
:: And *so Cos. Difference of the including Angles,* + *Cos. 3d* ∠ *: to versed Sine Supplement of included Side,* required.
:: And *so versed Sine Supplem. 3d Angle — versed Sine Diff. including Angles : to versed Sine Supplem. included Side,* required.
:: And *so versed Sine Supplem. Diff. including Angles — versed Sine 3d Angle : to versed Sine Sup. included Side,* required.

30. *If an Arc be drawn from the Vertex to the Middle of the Base of a spherical Triangle,*

Then, *the Sines of the vertical Angles are reciprocally as the Sines of the Sides, and directly as the Sines of the Angles at the Base.*

31. *If the vertical Angle of a spherical Triangle is bisected, As twice Cotangent of the bisecting Arc : to the Sum of the Cotangents of the Sides :: so Radius : to Cosine $\frac{1}{2}$ vertical Angle.*

32. As *double the Radius : to Tang. bisecting Arc :: so Sum Cotangents of Sides : to Cosine $\frac{1}{2}$ vertical Angle.*

33. As *one right Angle : to the Angle between 2 great Circles :: so the Area of a great Circle : to the* lunular Area *contained between those great Circles.*

34. As 4 *right Angles : to Angle intercepted between 2 great Circles :: so Surface of the whole Sphere : to Surface intercepted between those two great Circles.*
:: And *so the Solidity of the Sphere, : to the Solidity contained between the 2 great Circles.*
For the Solidities are as the Surfaces, because they may be reduced to Pyramids of equal Height.

35. In any spherical Triangle, As *two right Angles : to the Excess of 3 Angles above two right Angles, :: so the Area of a great Circle of a Sphere : to the Area of that Triangle.*

In any spherical *Polygon*, put $n =$ Number of Sides, $A = 180° \times \overline{n-2}$,

Then, As 2 right Angles, or 180° : To *Sum* of all the Angles of the *Polygon* — A :: So the Area of a great Circle of the Sphere : To Area of that *Polygon*.

CORRECTIONS *to be made in the* T t *Sheet, with the* PEN, *before it is used.*

Page	Col.	Line	For	Write
323	1	3 fr. Top	Buffin's, &c.	*Baffin's Bay.*
324	2	24	some Islands, &c.	some *other* Islands.
Same	2	3 fr. Bot.	Divisions	*Division.*
326		26 fr. Top	less / greater than 180°	than 90°.
328	4	Under Case 7, End of *Line* 1	*c* { − / +	*b* { − / +
		3	< > E	< > C.
		4	D ±	D ∓
		Beginning of Line 7	C = D — E	*c* = D — E.
	7	Under Case 2, Line 6	Sum and Dif. ver. ∠	Sum *or* Dif. ver. ∠s.

N. B. *m*D = $\frac{1}{2}$ $\overline{\text{BD} - \text{DA}}$, *or* $\frac{1}{2}$ BD, = $\frac{1}{2}$ *Dif. or* $\frac{1}{2}$ *Sum, Segments of Base, according as the Perpendicular falls within or without the Triangle; which Difference added to, and subtracted from* $\frac{1}{2}$ *the Base, or* $\frac{1}{2}$ BA, *gives the Segments* BD, *and* DA, *from where the Perpendicular falls, within; but which Sum doubled is the whole Base when the Perpendicular falls without.* See Fig. 1 and 2. Page 328.

SOME GENERAL OBSERVATIONS on the TIDES.

1. IF *you observe the Times of the Tides, in any Place, at* New *and* Full *Moon, and also their Times at the Quarter Moons, then if you proportion the* intermediate *Aspects of the* Moon *with the* Sun, *from these Times, you will have the Times of the Tides for each Day of the Moon's Age, in that Place,* very nearly.

2. AT London *the Tides, at the* Quarter-Moons, *happen* (generally) *above an Hour sooner than the middle Time, between the Tide Times, at* New *and* Full *Moon. Thus, at* London, *the Tide Times, at* New *and* Full, *are at about Half an Hour after two;* the middle Time *betwixt which Times, is* half an Hour after eight; *but the* Quarter Moon-Tides generally *happen, at* London, *about, or before, half an Hour after* Seven.

3. AT Dublin, *it is said, the Quarter Moon Tides happen half an Hour later than the* middle *Time counted from Tide-Times at New and Full.* Thus, *on New and Full, at the* Custom-house *of* Dublin, *the Tides happen about* 11; *the* middle *Time between which Times is about* 5, *for the Time of the* Quarter-*Tides: But they happen about* half an Hour *after* 5, *'tis said.*

4. THE *higher the Moon rises above (or farther she descends below) the Horizon of any Place, the* higher *the Tide rises in that Place.*

Therefore, *in North Latitudes, the Moon having North Declination, being above the* Horizon, *and past the Meridian, she raises higher Tides than when she is under the Horizon, and past the Meridian.*

☞ The contrary happens in North Latitudes and South Declinations of the Moon. Observe also the same in South Latitudes and South Declinations of the Moon. And the contrary in South Latitudes and North Declinations of the Moon.

5. *Consequently, in North Latitudes, in the* Summer, *(when the Ecliptic at Noon rises higher than in* Winter) *the Evening are higher than the Morning Tides. And, in* Winter *(when the Ecliptic, at Noon, is lower than in* Summer) *the Morning are higher than the Evening Tides.*

6. *The highest* Spring-Tides *are always a little* before *and* after *the* Equinoxes, *about the Beginning of* March, *and End of* September, *each Year; but the* Quarter *or* Neap-Tides, *are least at those Times, and greatest of all in* June *and* December, *about the* Solstices.

7. *The* highest *Tides make the lowest Ebbs.*

8. *Hence, the* highest *Tide, at* New *and* Full *Moon, is always followed by the* lowest *Tide at the* Quarter Moons.

9. *The highest* monthly Tides *are* generally *observed to be about the second Day after* Full *or* Change, *in* England; *but in some Places abroad, as at* Tonquin, *and* New Holland, *the highest* Spring-Tides *are observed to be* 3 *Days after* New *and* Full.

10. Tides, *in* like Circumstances, *are highest at the* Equator; *and higher in less than greater Latitudes.*

11. Tides *are higher in larger Seas, and lower in less Seas.*

12. Tides *are higher at the Shores of Continents, where there are* Rivers *and* Indraughts, *than in the Middle of the Sea, where they pass freely; or are higher at those Shores, than they are about* Islands, *far from the Continent.*

13. *Within* Rivers Mouths, *the Tides* ebb *longer than they flow.*

14. *The Motion of the* Tide *is* greatest *a little after half Flood, and a little before half Ebb.*

15. *A little before high Water in a* River, *the under Water of the* Tide *runs down, while the upper Water runs up.*

16. *At the Top of high or low Water, the Tide has no direct Motion.*

17. *Strong Winds blowing the same Way with the Running of the* Tide, *bring it in sooner and make it rise higher; but blowing contrarily, against the Tide's Motion, keep it back later, and make it run* lower.

TO *find the Time of* HIGH-WATER *at a given* TIME *and* PLACE?

RULE. By the following Tide-Table, find the Time of High-Water, or Full Sea, on the Day of *Full* or *Change* of the Moon, for the Place given; adding to which the Time of the Moon's *Southing* on the given Day, and the Sum will be the Time of High-Water for the Time and Place required. EXAMPLE. *To find the Time of high Water, at* London-Bridge, *on* May 10, 1760?

Time of High-Water at *New* and *Full* . .	2^h	30^m		So for the Rest.
On *May* 10, 1760, Moon souths	8	4	Morning	
High-Water at *London-Bridge*, then . .	10	34	Morning	
Add . . .	5	0		
Low Water at *Gravesend* . . .	3	34	Afternoon.	

An *Alphabetical* TIDE-TABLE, from the best AUTHORITIES. Shewing the TIME of HIGH-WATER at the most remarkable SEA PORTS and SEA-COASTS, when it is NEW or FULL MOON. For finding the TIME of High-Water in those Places at any AGE of the MOON.

Places NAMES.	Time H. Water. h	m
A.		
ABERDEEN, *Scotland*	0	45
Abermorith	6	0
Aberwark	4	30
Abroth	3	15
Africa, *West Coast*	3	0
Aldborough	9	45
Amazon's *R. Mouth*	6	0
Ambleteuse, Fr. Coast	11	0
America, W. *Coast*	3	0
——— E. *Coast*	4	30
Amsterdam	3	0
Andrews St.	2	15
Antwerp	6	0
Apenars	12	45
Apenmark, Fr. Coast	2	15
Archangel	6	0
Armentieres	3	0
Army	1	30
Audiern, Fr. Coast	2	15
Auray, Fr. Coast	3	45
B.		
BAJADOR, in *Barbary*	0	0
Baltimore, Ireland	4	30
Barfleur, Fr. Coast	7	30
Barneville, Fr. C.	7	0
Bass without	3	45
Bayonne, Fr. Coast	3	30
Beachy, Eng Coast	0	0
Beauvoir, Fr. Coast	3	15
Bell Isle	3	30
Berguer, Holland	1	30
Bermudas	7	0
Berwick	2	15
Biscay Coast	3	0
Blackness	1	30
Blackney	6	0
Blacktail Beacon	0	15
Blanket Race	0	0
Blavet	3	0
Bloy	4	30
Bluet without	2	15
Bourdeaux	6	0
Brasil Coast	4	30
Bremen	6	0
Bree Sound	4	30
Brest	3	15
Britain, S. Coast	3	0
Bridgewater	7	40
Bridlington Pier	4	0
Brille	1	30
Bristol	6	30

Places NAMES.	Time H. Water. h	m
Bristol Key	6	45
Brovage without	3	45
Buchaness	3	0
Bulloign	11	0
Buoy of Nore	1	0
C.		
CAEN, Normandy	9	0
Caldy	5	15
Calais	11	30
Calshot	11	15
Camvere	1	30
Canary Isles	3	0
Cancale	6	0
Cape Blanco	9	45
—— *Cantin*	0	0
—— *Clear*	4	30
—— *De Four*	2	45
—— *of good Hope*	3	0
—— *Sierre de Lion*, in *Guinea*	8	15
Carmarthen Bay	5	15
Caskets without	8	15
Caskets within	9	45
Catness	9	0
Chamberness	9	45
Cherburgh	7	30
Chili Coast	3	0
Concarneau, Fr. C.	3	0
Condado	0	0
Conquet, Fr. Coast	2	15
Cork	6	30
CorpusChristiPoint	1	30
Cowes	10	30
Croyl	11	15
Cromer	7	0
D.		
DARTMOUTH	6	30
David's Head	6	0
Deal	10	30
Denbigh	2	15
Desire Port, in *America*	0	0
Dieppe	10	30
Dort	3	0
Dover	11	30
Downs	1	15
Dublin Bar	9	15
——— *Custom house*	11	0
Dunbar	2	0
Dundee	2	15
Dungarven	4	30
Dungeness	9	45
Dunkirk	12	0

Places NAMES.	Time H. Water. h	m
Dunnose	9	45
Dunwich	9	45
E.		
EDAM	1	30
Edinburgh	4	30
Egmon	4	30
Eider	0	0
Elbe	0	0
Embden	0	0
Emes	9	0
Emes Entrance	7	30
Enchusen	0	0
Engomonts	9	0
Estaple	11	0
Exmouth	6	20
Exwater	7	30
F.		
FAIR ISLE	0	0
Fair Isle Roads	11	15
Falmouth	5	30
Fen, in E. Channel	1	30
Fescan	9	45
Finkmark Coast	1	30
Flamborough-Head	4	c
Flanders Banks	1	0
Florida	7	30
Flushing	1	0
The *Fly*	7	30
Fontenay Race	2	15
Foreland, N. and S.	9	45
Forn	5	15
Foulness	6	45
Fowey	5	30
France, W. *Coast*	3	0
Firth	11	0
Friesland Coast	7	30
G.		
GALLICIA	3	0
Garande	3	0
Garonne Mouth	3	0
Gascoigne Coast	3	0
Gibraltar Road	0	0
Gouries Gut	2	30
Goree	1	30
Gorend	11	15
Granville	6	45
Gravelling	0	0
Gravesend	1	30
Groyne	3	0
Guernsey	1	30
Gunfleet	10	30

Places NAMES.	Time H. Water. h	m
H.		
HAGUE	8	15
Hamborough	6	c
Hampton Key	0	0
Harborough	6	0
Harfleur	8	0
Haerlem	9	0
Hartlepool	3	0
Harwich	11	0
Hastings	10	30
Havre de Grace	9	0
St *Helens*	10	30
Hern	0	0
Hever	0	0
Holms	6	0
Holy Head	1	30
Home Head	9	0
Honfleur	9	0
Horn	1	30
Hull	6	0
Humber Mouth	5	15
Huncliff-Foot	3	45
I.		
JOHN-DE-LUCE	10	30
Ireland S. *Coast*	5	15
——— W. *Coast*	3	0
Jutland Isle	0	0
K.		
KENTISH KNOCK	0	0
Kildive	9	0
Kilduyn	7	30
Killiars	3	0
Kinsale	5	15
L.		
LAMBAY	8	15
Landsend	7	30
Lanion	6	45
Lawrencess	4	30
Leith	4	0
Lenow	9	45
Leostoff	9	45
——— *Road*	10	30
Lime	7	0
Lisbon	2	15
Lizard	7	30
London	2	30
Longsand Head	10	30
Loo	6	0
Loir Mouth	3	0
Lundey	5	15
Lynn, Norfolk	6	0
Lynn, without	5	15

N. B. $0^h\ 0^m$ signifies $12^h\ 0^m$, at Noon, or Midnight.

Alphabetical TIDE-TABLE continued.

Places NAMES.	Time H. Water. h	m
M.		
Mackwell's Castle	8	15
Maze	3	0
Magnes Sound	8	15
Malden	12	45
St. Maloes	6	0
Man Isle	9	0
Margaret Road	11	15
St. *Mark*	2	15
St. *Matthew's Point*	3	45
Mamissan	3	30
Milford, and *Moonl[illegible]*	5	15
Milford Haven	7	30
Morbiham	3	0
Mount's Bay	4	30
Mouse-hole	4	30
N.		
Nantz River	3	0
Naze	11	15
Needles	10	0
Newcastle	3	15
Newport (I. Wight)	0	0
St. *Nicholas*, in *Russia*	6	45
Nore, W. End	0	0
Normandy Coast	10	30
North Cape, *Maggero*	3	0
O.		
Ollone	3	15
Orfordness	10	30
Orkneys	6	0
Orwell	9	0
Ostend	0	30
P.		
Pennes, Fr. C.	3	45
Peru Coast	3	0
Peter Port	8	15
Picardy Coast	10	30
Plymouth	6	0
Podesemsk, (Russia)	6	45

Places NAMES.	Time H. Water. h	m
Poictu, S. Coast	3	0
Port-Blank	4	15
Porthus	3	0
Portland	8	30
Portugal Coast	3	45
Portsmouth	12	30
Q.		
Quebeck (Canada)	6	0
Queenborough (Isl. Shippy)	0	0
R.		
Ramekins	1	30
Ramsey	5	15
Rebdan	12	45
Redsand	0	30
Rhee Isl.	3	0
Rhodes	11	15
Robin Hood's Bay	3	0
Rochel	3	45
Rochfort	4	15
Rochester	0	45
Rohan	3	45
Ross	5	15
Rotterdam	3	0
Rouen	1	15
Rumney	1	30
Rye	11	15
S.		
Saint Andrews	2	15
— *Augustine* (Florida)	7	30
— *David's Head*	6	0
— *Helen's*	10	30
— *John de Lutz*	3	30
— *Lucas*	2	15
— *Malos*	5	30
— *Mark*	2	15
— *Matthew's Point*	3	45
— *Michael*	5	30
— *Nicholas* (Russia)	6	45
— *Pol de Leon*	4	0
— *Powls*	6	0
— *Valleri*	9	45
Salcomb	6	0

Places NAMES.	Time H. Water. h	m
Sandwich	11	30
Scarborough	3	45
Scilly Islands	3	45
Sedmouth	6	45
Senegal	10	30
Seven-Cliffs	9	0
Seven Isles	4	30
Severn's Mouth	6	0
Seine's Mouth	9	0
Sheerness	0	0
Shelbergh	9	0
Shetland	3	0
Shoe-Bacon	0	30
Shoreham	10	30
Sleeve	0	0
Somme Mouth	11	0
Sound	3	45
Southampton	0	0
Spain, W. Coast	3	0
Spithead	11	30
Spits	0	0
Spurn	5	15
Staples	3	45
Start	6	45
Stockton	5	15
Swin	0	0
T.		
Tees Mouth	3	0
Tenerif	3	0
Tenet	1	30
Terveer within	0	45
——— without	1	30
Tergon	9	45
Texel	7	0
Texel Cliffs	5	0
Thames Mouth	1	30
Tinmouth	6	0
Topsham	6	0
Torbay	6	0
Treport	10	30
V.		
Vannes	3	45
Voard	4	30
Vreck	0	0
Use	3	0
Ushant within	4	30

Places NAMES.	Time H. Water. h	m
W.		
Wales	5	15
Wash (Lincolnshire)	6	30
Waterford	6	30
Wetlands	1	30
Wells	6	0
Weymouth	7	0
——— *Key*	6	45
Whitby	3	0
Wieringham	7	0
Wight Isle	0	0
Winchelsea	12	45
Winterton	8	0
Y.		
Yarm	6	45
Yarmouth, Norfolk	10	0
——— *Roads*	10	30
Youghall (Ireland)	4	30
Z.		
Zeland Coast	1	30
Zerick-Sea	3	0

N. B. The above TIDE-TABLE is settled from the best Authorities we could procure; yet it is not improbable the Times of *High-Water* in some Places are not exactly as are here set down — We shall be obliged to Persons residing at the Places to inform us of any Mistake; there being no Way to come at Certainty in these Matters, but from living Authors, who have frequently observed the Times of highest Tide, at New and Full Moon, in different Places.

OBSERVATIONS

OBSERVATIONS on the *different* BEGINNINGS of LONGITUDES.

1. THE *Difference* of Longitude between the Meridian of an Obfervatory and fome *diftant Meridian*, is *chiefly* wanted for determining the *Longitude*, *Declination*, or right Afcenfion of the *Sun*, *Moon*, or *Planet* under that *fecond* Meridian, from their *Data* at the *firft*, on a given Day and Year, with alfo their given diurnal Increafe or Decreafe.

2. As there muft be a *Queftion* anfwered to determine the Difference of Longitude betwixt any two Meridians, whofe Longitudes, according to *antient Cuftom*, are given from *Ferro*, the fame Queftion may be as readily anfwered from the Longitudes Eaft or Weft, counted from another given Meridian. But if the Longitudes of Places are given at once from the *Metropolis* or *Obfervatory* of any *particular Nation*, they are ready (without determining them) for the Service of that Nation's Navigation, to afcertain the Longitude, Declination, or right Afcenfion of the cœleftial Bodies under a diftant Meridian. And on which Account we have given an extenfive SEA-COAST TABLE, following, with the Difference of Longitudes from *Greenwich*, according to modern Cuftom, as well as the correfponding *abfolute* Longitudes, according to antient Cuftom, from *Ferro*, which modern Cuftom has almoft fuperfeded.

Examples of the equal Facility of both thefe Ways of finding the required Difference of Longitude of Places, are feen in Page 317.

3. Hence future *Aftronomers* and *Navigators* may compare the Longitudes of Places obferved with thefe we have given from *Ferro*, or *Greenwich*, as a *near* STANDARD of the Truth; and may thence make their future Improvements, or Confirmation of our following Numbers, P. 337, &c.

☞ THE *Revifer of the* Seaman's Calendar newly rectified, *at Page* 243, *having regretted the Want of an Order of Parliament for caufing Agreement among thofe concerned in fettling the Beginning of Longitudes of Places (now confounding the inexperienced Navigators by fo many different Countings and Beginnings thereof) we hope our Endeavours here have come up to his Wifhes, and anfwered his Objections.*

ASTRONOMICAL QUESTION, of great USE in NAVIGATION.

AT *a given Time of the Year, in a given Latitude, the Times being given by a Clock or Watch, when the* Sun *was obferved to have his Forenoon and Afternoon Altitudes alike, to determine from thence, the Time by the fame Clock, or Watch, when the* Sun *paffed the Meridian?*

The ANSWER.

Put L = the Latitude of the Place, where the two Obfervations were made.
D = Sun's Diftance from the Pole, at *Noon.*
T = $\frac{1}{2}$ Time (τ) between the *two Obfervations*, in Degrees and Decimals.
V = $\frac{1}{2}$ the Variation of the Sun's Declination, in that Time (τ) in Seconds of Time.
M = *Middle*-Time between the Obfervations, or $\frac{1}{2}\,\tau$ added to the Time of Forenoon-Obfervation.

Let $\frac{s'.T \times t'L}{r} = t.A$ like T; and B = D *Dif.* A.

Then $\frac{s.B \times t'.T}{s.A \times s.D} \times V = N$, Seconds of Time, the Correction or *Interval* between M, and the *true* Time of Noon.

And, M ± N = Time by the *Clock* or *Watch*, when the SUN was on the Meridian, acccording as he is in {♋, ♌, ♍, ♎, ♏, ♐, descending / ♑, ♒, ♓, ♈, ♉, ♊, ascending} Signs.

SPHERICAL QUESTIONS anfwered.

1. *The Hypothenufe, and Sum or Diff. of the Legs of a right-angled fpherical Triangle being given to find the Triangle?*
ANSWER. From twice the Cof. of the Hypoth. fubtract the Cofine of Sum or Diff. of Legs, the Remainder will be the Cof. of an Arc, which being *added* to the faid Sum, or Diff. gives the Double of the greater Leg, required.

2. *One Leg, and the Sum, or Difference of the Hypothenufe and the other Leg, to find the Hypothenufe?*
ANSWER. As Cof. $\frac{1}{2}$ Leg given, : to its Tangent :: fo the Cot. $\frac{1}{2}$ Sum of Hyp. and other Leg, : to Tan. $\frac{1}{2}$ their Difference.

3. *The ∠ at the Bafe, and Sum or Diff. of the Hypothenufe and Bafe, given, to find the fpherical Triangle?*
ANSWER. As Cotangent $\frac{1}{2}$ ∠ given, : to its Tangent :: fo Sine Sum of the Hyp. and adj. Leg : to Sine of their Difference.

4. *The Hyp. and Sum or Diff. of the two adjacent ∠s given, to find the Angles.*
ANSWER. As Cot. $\frac{1}{2}$ the Hypothenufe : to its Tangent :: fo Cof. Diff. two ∠s : to Sine of the *Excefs* of their *Sum* above a right Angle.

OBSERVATIONS on the ANSWERS to MARTIN's or MURDOCH's EXAMPLES, and on the *Remarks* by *Newtoniensis*, on SPHEROIDAL SAILING, Page 283.
With the ONLY INSTANCE (in a long RUN) *wherein* SPHEROIDAL SAILING *is approved: Which Sailing*, in general, *having no real* ADVANTAGE, *the different meridional Parts of the* SPHEROID *are inserted to prove it, and shew the Extent of its* USE.

OUR Correspondent *Newtoniensis* obſerves, on his *firſt Remarks*, Page 296, on *B. Martin*'s Navigation, his Meaning is, *That all* B. Martin's *Examples are like* Murdoch's, *in reſpect of their being what never happen in Practice, and that ſome* Examples *are numerically the ſame as what are given by* Murdoch. — What is become of this *Bray*, Page 297, Line 3. Bottom, ſhould be this *Brag*. —— *Newtoniensis* further obſerves. —

What we had to do with *all thoſe Examples* was only to ſhew that the ſeveral *Caſes* of *Sailing* might be *differently* anſwered, both according to the *Sphere* and *Spheroid*, by *our Computers*, N°. I. II. III. more eaſily than by the common Methods in *Practice*; at the ſame Time we gave *Inſtance*, or made Compariſon, of our correct Anſwers with the Anſwers given by *B. Martin* to the ſame Queſtions or Caſes of Sailing. Whether all Mr. *Martin*'s Examples of the Caſes of Sailing are the ſame in all Reſpects with Mr. *Murdoch*'s, we had no further Regard to, than to ſhew how much *ſpheroidal* Navigation differs from itſelf, according to the different *ſpheroidal* Figures of the Earth, aſſumed by *B. Martin* from *Maupertuis* or *Murdoch*, and from *Juan*: the Form thereof, by the laſt of which Authors, being conſidered as much the *neareſt to Truth*, and Sir *Iſaac Newton*'s Theory.

The different *ſpheroidal* meridional Parts, according to *Murdoch* and *Juan*, are inſerted in *our Work* for the *Navigator* to compare their Uſe in any *Caſe of Sailing*, he chuſes to make Trial of, and alſo to try their Uſe, *reſpectively*, with the meridional Parts of the *Sphere*. By which he will find that *ſpheroidal* Navigation, according to *Martin* or *Murdoch*, differs more from *ſpheroidal* Navigation, according to *Juan*, than *Juan*'s differs from the Navigation of the Sphere.

And the *only Inſtance*, wherein the ſpheroidal meridional Parts that we have inſerted and contraſted with thoſe of the Sphere, are deſigned to be applied to Practice, for determining the Ship's *Place*, *is when you are ſure that your Courſe and Diſtance, in a long Run, are both very corr.ct.* Which Ship's *Place* may then ſerve to compare with the *Reſult* of your ſeveral daily Reckonings on that Courſe, according to the common Navigation of the Sphere, and thereby to mark the *Difference in Longitude*, according to the moſt correct Form of the terreſtrial Spheroid yet diſcovered. A bare *Quotation* of a *few* Numbers or meridional Parts of the *Spheroid* the moſt approved, though of *equal* Authority with the Truth of a greater Number given, could not have evinced their *Utility* or *Inutility*, in the Extent thereof, ſo well as by the 6 half Pages, to every other Minute of the Quadrant, and Length of the *Arches* to every Degree of Latitude, as we have inſerted.

☞ REMARK. *Since our printing the* 6th *and* 7th *Caſes of* Mercator-Sailing, *we have obſerved, that the* 6th Caſe *and its* Variation *printed in the* Miſcellanea Curioſa, *for the Months of* January, February, *and* March, 1734, *by Mr.* John Turner *of* York, *our deceaſed Friend and Correſpondent; being the* 7th Queſtion *there; though we propoſed both thoſe* Caſes *without having obſerved them elſewhere; nor have we ſeen either of theſe Caſes propoſed in any Work of* Navigation *but our own, though they are chiefly ſpeculative.*

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3 **VARIATION of CASE 6th of MERCATOR SAILING.** (See *Page* 505.)

A Ship failed from a Port in Latitude 54° N. *upon an unknown Courſe between the* S. *and the* W. *till her Departure was* 44′.45 *Miles, and her Difference of Longitude* 74′.17 *Miles, required, from thence, her Courſe, Diſtance run, and Difference of Latitude?*

ANSWERED by the DIRECT METHOD of *Solution*.

PUT $x =$ Length of the Arch of Latitude arrived in; then, according to Dr. *Halley* (in Vol. I. *Philoſ. Tranſ.*) the meridional Parts of that Latitude will be $= \frac{1}{a} \times x + \frac{1}{6}x^3 + \frac{1}{24}x^5 + \frac{1}{83}x^7 + \frac{1}{262}x^9$, &c. (where $a =$ the Length of the Arch of 1 Min. $=$,00029088, and conſequently $\frac{1}{a} = 3438$.) Now, to make all the Parts of the *Mercator-Triangle* alike, multiply the Departure and alſo Difference of Longitude by a. Let $44'.45 \times a = c$; and $74'.17 \times a = d$; and $54°, \times 60 \times a = b$; $n = 3864$, the merid. Parts for Lat. 54°.

Then, $n - x - \frac{1}{6}x^3 - \frac{1}{24}x^5 - \frac{1}{83}x^7 - \frac{1}{262}x^9$, &c. $=$ merid. Diff. Latitude; the prop. Diff. Lat. $= b - x$; Say, $b - x : c :: n - x - \frac{1}{6}x^3 - \frac{1}{24}x^5$, &c. $: d$; whence (by multiplying Extreams and Means) we have, $\frac{bd - dx}{c} = n - x - \frac{1}{6}x^3 - \frac{1}{24}x^5 - \frac{1}{83}x^7 - \frac{1}{262}x^9$, &c.

Put $\frac{bd}{c} = m$, $\frac{-d}{c} = -p$; and $m - px = n - x - \frac{1}{6}x^3$, &c. Then, by Tranſpoſition, $n - m = \overline{1-p}x + \frac{1}{6}x^3 + \frac{1}{24}x^5 + \frac{1}{83}x^7$, &c.

Put $n - m = q$, $1 - p = f$, and Letters for the known Coefficients of the Powers of x. Then, $fx + rx^3 + sx^5 + tx^7 + gx^9$, &c. $= q$.

By *Reverſion* of Series $x = \frac{q}{f} - \frac{rq^3}{f^4} + \frac{3r^2 - fs}{f^7}q^5 + \frac{8frs - f^2t - 12r^3}{f^{10}}q^7 + \frac{55r^4 - 55fr^2s + 10f^2rt + 5f^2s^2 - f^3g}{f^{13}}q^9$, &c. $=$,9231.

Now, x, or the Length of the Arch being known, the correſponding Latitude in Degrees is thus found, by ſaying, As 1.5708 : 90° :: ,9231 : 52°,89 = 52°,53′, the Latitude arrived in. — Whence the proper Dif. of Lat. is 67′ : Dep. 44′.45 :: Mer. Lat. 112 : Dif. Long. 74 Miles; And Diſtance run 80′ Miles; *Courſe* (by Computer, N°. I.) 33° 7′¼ S. Weſterly.

3 ☞ *The indirect Method of Solution, by* Trial *and* Error, (ſee Page 505) *is preferable.*

3 **CASE 6th of MERCATOR-SAILING.** (*See Page* 505.)

A Ship ſails from a Place in Latitude 54° N. *Diſtance* 80′ *Miles, and finds her Dif. of Long. to be* 74′.17 *Miles, required her Courſe, Departure, and Difference of Latitude?*

Anſwered by the DIRECT METHOD of *Solution*.

In this Caſe, by 47. e. 1. (taking the ſame Letters as in the former Caſe) As $b - x$ proper Dif. Lat. : $\sqrt{c^2 - b^2 + 2bx - x^2}$ the Departure :: $n - x - \frac{1}{6}x^3 - \frac{1}{24}x^5$, &c. Mer. Dif. Lat. : d, Dif. Longitude. Whence, we have an *infinitonomial* Equation to be ſquared, and then the Value of x is had by Reverſion of *infinite Series*, if any Body chuſes to take the Time and Trouble.

3 ☞ *The indirect Method of Solution, by* Trial *and* Error (*Page* 505) *is preferable.*

The

The MARINER'S SEA-COAST TABLE.

Of the principal *Ports*, *Harbours*, *Head-Lands*, *Bays*, *Rivers-Mouths*, and *Islands*, lying contiguous round the WORLD. With their Latitudes, North or South, and Longitudes East from *Ferro Island*; also their *Difference of Longitude* East or West, from GREENWICH OBSERVATORY. According to the *best Authorities*, and *some** according to the correctest Observations.

☞ *The Latitudes and Longitudes of Places marked with a * are from correct and repeated Observations. The Rest are* improveable, *or want* Confirmation.

I. The *Coast* of ENGLAND
II. ——— SCOTLAND
III. ——— IRELAND
IV. ——— HOLLAND and FLANDERS
V. ——— FRANCE and PORTUGAL } EUROPE.
VI. ——— The MAIN CONTINENT
VII. ——— The *Islands* } within the Straits.
VIII. ——— BARBARY and GUINEA
IX. ——— The *Western*
X. ——— The *Canary*
XI. ——— The *Cape de Verd*
XII. ——— The *Southern* } ISLANDS } AFRICA.
XIII. ——— The *Main* CONTINENT
XIV. ——— The ISLANDS } in the *East Indies.* } ASIA.

XV. The *Coast* of AMERICA in the *South-Sea*, from *California* to *Cape Horn*
XVI. ——— BRAZIL in *South America*, from Cape *Horn* to Cape ROQUE
XVII. ——— The Main CONTINENT of the *West Indies*
XVIII. ——— The *Caribbee*
XIX. ——— The *Bahama* } ISLANDS
XX. ——— CAROLINA, VIRGINIA, MARYLAND, PENSILVANIA, NEW ENGLAND, and NEWFOUNDLAND
XXI. ——— HUDSON'S BAY and the *Straits*
XXII. ——— ICELAND, GREENLAND, NOVA ZEMBLA, and the *Northern* ISLES } AMERICA.
XXIII. ——— The SOUND and BALTIC, EUROPE.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E. or W.
I. COAST of ENGLAND.			
	° ′	° ′	° ′
1. BERWICK	55 48	15 55	1 45 W
2. *Newcastle*	55 12	16 5	1 35 W
3. Sheilds	55 2	16 12	1 28 W
4. Sunderland	54 55	16 15	1 25 W
5. Hartlepool	54 43	16 39	1 1 W
6. Stockton	54 33	16 10	1 30 W
7. Whitby	54 26	16 45	0 55 W
8. Scarborough	54 20	16 55	0 45 W
9. Humbro-Head	54 8	17 46	0 6 E
10. Burlington	54 0	17 43	0 3 E
11. Spurn	53 45	17 48	0 8 E
12. *Hull*	53 52	17 15	0 25 W
13. Grimsby	53 30	18 31	0 51 E
14. Boston	53 10	18 0	0 20 E
15. *Lynn*	52 55	18 7	0 27 E
16. Wells	53 10	18 35	0 55 E
17. Blakeny	53 8	18 30	0 50 E
18. Cromer	53 10	18 40	1 0 E
19. Winterton	52 57	18 57	1 17 E
20. *Yarmouth*	52 42	19 13	1 33 E
21. Aldborough	52 16	19 3	1 23 E
22. Orfordness	52 12	18 51	1 11 E
23. *Ipswich*	52 10	18 40	1 0 E
24. Harwich	52 5	18 53	1 13 E
25. Colchester	51 58	18 31	0 51 E
26. LONDON*	51 31	17 35	0 5 W
27. *Rochester*	51 28	18 1	0 21 E
28. Margate	51 27	18 49	1 9 E
29. *North* Foreland	51 27	18 59	1 19 E
30. Sandwich	51 25	18 49	1 9 E
31. The Downs	51 23	19 0	1 20 E
32. *South* Foreland	51 10	18 55	1 15 E
33. Ripraps-Sand	51 53	19 1	1 21 E
34. Dover	51 6	18 53	1 13 E
35. Dongeness	50 57	18 26	0 46 E
36. Rye	51 2	18 20	0 40 E
37. *Beachy*	50 46	18 0	0 20 E
38. Shoreham	50 55	17 18	0 42 W
39. *Portsmouth*	50 49	16 35	1 5 W
40. I. *Wight*, Newport . . .	50 42	16 10	1 30 W
41. Pool	50 56	15 41	1 59 W
42. Weymouth	50 42	14 55	2 45 W
43. Portland	50 30	14 51	2 49 W
44. Chiddock	50 46	14 35	3 5 W
45. Lime	50 45	14 20	3 20 W
46. Topsham	50 38	14 7	3 33 W
47. The *Berry*	50 25	13 46	3 54 W
48. Torbay	50 32	13 56	3 44 W
49. Dartmouth	50 26	13 57	3 43 W
50. The *Start*	50 7	13 48	3 52 W
51. The *Eddystone*	50 10	13 11	4 29 W
52. *Plymouth*	50 31	13 18	4 22 W
53. Ramhead	50 16	13 0	4 40 W
54. Foy	50 24	13 0	4 40 W
55. *Falmouth*	50 11	12 25	5 15 W
56. LIZARD*	49 55	12 55	4 45 W
57. Land's End	50 0	11 35	6 5 W
58. *Gulf*-Rock	49 56	11 49	6 11 W
59. SCILLY *Islands*. St. *Mary's*	50 0	10 50	6 50 W
60. *Seven* Stones	50 10	10 55	6 45 W
61. Hartland Point	51 10	13 0	4 40 W
62. Lundy Isle	51 20	12 55	4 45 W
63. Mort-Bay, or Point . .	51 12	12 55	4 45 W
64. *Bristol*	51 33	13 0	4 40 W
65. Swandsey	51 40	13 10	4 30 W
66. Caldy-Island	51 33	12 21	5 19 W
67. Milford	51 45	12 20	5 20 W
68. *St. David's Head* . .	52 0	12 13	5 27 W
69. Bardsy-Isle	52 44	12 35	5 5 W
70. *Liverpoole*	53 20	14 35	3 5 W
71. *Westchester*	53 37	13 15	4 25 W
72. Lancaster	54 42	12 59	4 41 W
73. White-Haven	54 17	14 5	3 35 W
74. Isle of *Man*, W. End . . .	53 45	12 35	5 5 W
75. *Holy Head*	53 24	12 45	4 55 W
76. *Carlisle*	54 47	14 30	3 10 W
II. COAST of SCOTLAND.			
	° ′	° ′	° ′
1. SKY ISLAND, N. End . .	57 45	11 50	5 50 W
2. St. Kilday	57 52	7 50	9 50 W
3. Island of *Lewis*, N. End . . .	58 20	10 35	7 5 W
4. Farro-Head, or C. Wrath . .	58 34	12 25	5 15 W
5. *Shetland*, S. End	60 4	15 35	2 5 W
6. Fair-Isle	59 30	15 15	2 25 W
7. Isles of Orkney	59 10	14 13	3 27 W
8. Cathness Point	58 40	14 59	2 41 W
9. Buchanness	57 45	16 17	1 23 W
10. *Aberdeen*	57 22	15 45	1 45 W
11. Dundee	56 28	14 45	[illegible] 45 W
12. Leith	56 [illegible]	14 30	3 1 W
13. EDINBURGH*	55 58	14 35	[illegible] 5 W
14. *Glasgow*	55 52	13 30	4 10 W
III. COAST of IRELAND.			
	° ′	° ′	° ′
1. FAIR FORELAND	55 5	11 5	6 35 W
2. *Londonderry*	55 0	9 45	7 55 W
3. Belfast	54 39	11 5	6 35 W
4. Island-Torr	55 9	9 5	8 35 W
5. Isles of Arran	54 8	8 30	9 4 W
6. Stags of Broad Haven . . .	54 7	7 20	10 11 W
7. Isles of *Arian*	54 55	7 45	9 55 W
8. Galway	53 7	7 55	9 45 W
9. Gall, or Doen's Head	52 40	8 5	9 35 W

The MARINER'S SEA-COAST TABLE.

III. COAST of IRELAND continued.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
10. Lupis's Head	52 24	7 20	10 20 W
11. Limerick	52 23	8 0	9 40 W
12. Galway	53 7	7 55	9 45 W
13. Sline Head	53 20	5 40	11 20 W
14. Blasques	52 0	5 39	12 1 W
15. Shilloks	51 30	5 40	12 0 W
16. *Cow* and *Calf*	51 22	6 59	10 41 W
17. *Mizen*-Head	51 16	6 5	11 35 W
18. Old Head of Kinsale . . .	51 35	8 37	9 3 W
19. Cape *Clear*	51 17	6 25	11 15 W
20. Kinsale	51 50	7 55	9 45 W
21. *Cork*	51 49	8 5	9 35 W
22. Waterford	52 9	8 55	8 45 W
23. Wexford	52 13	10 8	7 32 W
24. DUBLIN	53 12	10 39	7 1 W
25. Lambay-Island	53 24	12 5	7 35 W

IV. COAST of HOLLAND and FLANDERS.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
1. SCAW	57 30	27 55	10 15 E
2. Holy Land, or Helighland Isle	54 24	26 10	8 30 E
3. Hamburgh	53 41	28 15	10 35 E
4. Bremen	53 30	26 35	8 55 E
5. Embden	53 5	25 10	7 30 E
6. Ameland-Island	53 30	23 55	6 15 E
7. Scheling	53 27	23 33	5 53 E
8. The Fly	53 16	23 5	5 25 E
9. The Texel	53 15	22 45	5 5 E
10. AMSTERDAM*	52 23	22 39	4 59 E
11. *Rotterdam*	51 55	22 5	4 25 E
12. Antwerp	51 10	21 55	4 15 E
13. The *Brill*	52 0	21 35	3 55 E
14. Middleburgh in Zealand	51 37	21 33	3 53 E
15. Sluys	51 14	21 18	3 38 E
16. *Ostend**	51 14	20 36	2 56 E
17. *Dunkirk**	51 2	20 2	2 22 E

V. COAST of FRANCE and PORTUGAL.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
1. CALAIS*	50 58	19 29	1 49 E
2. Dieppe	49 56	18 44	1 4 E
3. St. Valery	50 10	18 31	0 51 E
4. *Sain*-Head, or Cape *de Antifer*	49 44	18 9	0 29 E
5. *Rouen* Mouth	49 34	18 5	0 25 E
6. Cape Barfleur	49 43	16 21	1 19 W
7. Cape de la Hogue	49 47	15 35	2 5 W
8. Alderney	49 50	15 23	2 17 W
9. Caskets	49 50	15 15	2 25 W
10. *Guernsey*	49 33	14 55	2 45 W
11. *Jersey*	49 15	15 15	2 25 W
12. St. *Maloes**	48 39	15 38	2 2 W
13. Morlaix	48 33	13 46	3 54 W
14. Island de *Bass*	48 50	13 35	4 5 W
15. Ushant	48 30	12 33	5 7 W
16. Conquet	48 27	12 35	5 5 W
17. *Brest**	48 23	13 9	4 31 W
18. Camarita Bay	48 25	13 7	4 33 W
19. Seams	48 2	12 35	5 5 W
20. West Penmark	47 48	13 11	4 29 W
21. *Bell-Isle*	47 18	14 19	3 21 W
22. *Nantz**	47 13	15 56	1 44 W
23. Island Dieu	46 34	15 22	2 18 W
24. Hey's Isle	46 24	15 21	2 19 W
25. Island de Rey, the Middle	46 10	16 5	1 35 W
26. Isles of Oleron	45 56	16 35	1 5 W
27. *Rochel**	46 10	16 24	1 16 W
28. *Bourdeaux**	44 50	17 6	0 34 W
29. St. Sebastian	43 24	16 8	1 32 W
30. Bilboa	43 29	14 37	3 3 W
31. Cape Pinas	43 56	11 35	6 5 W
32. —— Ortegal	44 4	9 47	7 53 W
33. —— Corumna or Groin	43 28	8 15	9 25 W
34. —— Finister	43 12	7 55	9 45 W
35. Isles of Bajona	42 29	8 8	9 32 W
36. *Oporto*	41 10	8 10	9 30 W
37. Burlings	39 35	8 11	9 29 W
38. Rock of Lisbon	38 52	7 45	9 55 W
39. *Lisbon**	38 42	8 42	8 58 W
40. Cape St. Vincent	36 53	8 29	9 11 W
41. Cape St. *Maria*	36 58	9 5	8 35 W
42. *Cadiz**	36 33	11 38	6 7 W
43. Cape Trefalgar	36 10	11 34	6 6 W

VI. COAST *on the Main* CONTINENT *within the* STRAITS.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
1. GIBRALTAR	36 12	12 42	4 58 W
2. Malaga	36 48	13 45	3 55 W
3. Cape *de Gat*	36 40	15 55	1 45 W
4. Cape *Paul*	38 15	17 40	0 0 E
5. Alicant.	38 35	17 50	0 10 E
6. Cape St. Martin	38 46	18 15	0 35 E
7. *Barcelona**	41 26	19 53	2 13 E
8. *Marseilles**	43 18	23 2	5 22 E
9. *Toulon**	43 7	23 37	5 57 E
10. Genoa	44 25	26 18	8 38 E
11. Leghorn	43 28	28 10	10 30 E
12. Civita Vechia	42 10	30 0	12 20 E
13. *Rome**	41 54	30 9	12 29 E
14. *Naples**	40 51	32 20	14 40 E
15. *Cape* Spartavento	37 55	34 30	16 50 E
16. *Cape* Colonne	38 56	35 0	18 0 E
17. Gallipoli	39 56	36 16	18 36 E
18. Cape St. *Maria* or *Lucia*	39 45	36 35	18 55 E
19. Ancona	43 40	32 1	14 21 E
20. *Venice**	45 25	29 45	12 5 E
21. Zara	44 30	34 10	16 30 E
22. Ragusa	42 55	36 25	18 45 E
23. Cattaro	42 47	36 52	19 12 E
24. La Valona	40 45	38 0	20 0 E
25. Point Palerma	40 0	37 50	20 10 E
26. Lepanto	38 10	40 27	22 47 E
27. Cape *Matapan* or Caliga . .	36 33	40 16	22 36 E
28. *Cape* St. *Angelo*, or Angulo	36 32	41 31	23 51 E
29. *Athens**	38 5	41 32	23 52 E
30. *Cape* Martelo, S. Point of Negropont	38 7	42 38	24 58 E
31. *Cape* Colonne	37 45	42 17	24 37 E
32. Salonica	40 41	40 48	23 8 E
33. Cape Monte Sancto . . .	40 26	42 37	24 57 E
34. Gallipoli	40 33	44 55	27 15 E
35. *Constantinople**	41 0	46 33	28 53 E
36. Cape Barbador, or Baba . . .	39 30	44 5	26 25 E
37. *Smyrna**	38 28	45 0	27 20 E
38. Cape Babernola, or Blanc . . .	38 9	44 7	26 27 E
39. Ephesus	38 1	45 28	27 48 E
40. Antiochetta	36 30	50 21	32 41 E
41. Scanderoon, or Alexandretta	36 34	54 5	36 25 E
42. Antiocha	36 11	54 0	36 20 E
43. *Aleppo**	35 45	55 0	37 20 E
44. Tortosa	35 0	54 5	36 25 E
45. Tripoly	34 38	53 50	36 10 E
46. Joppa, or Jaffa . . .	32 27	53 55	35 15 E
47. *Jerusalem**	31 55	53 0	35 20 E
48. *Alexandria**	31 7	47 57	30 17 E
49. Cape Rusato	32 48	39 0	21 20 E
50. Cape Mesurato . . .	32 21	33 52	16 12 E
51. *Tripoly**	32 54	30 45	13 5 E
52. Susa	35 53	28 9	10 29 E
53. Cape Bona	37 3	28 30	10 59 E
54. Tunis	36 50	27 52	10 12 E
55. Bona	37 2	25 54	8 14 E
56. *Seven* Capes	37 15	24 35	6 55 E
57. Gigeri	37 14	23 50	6 10 E
58. Cape Tidelles, or Dellys . .	37 15	21 53	4 13 E
59. *Algier**	36 50	20 51	3 11 E
60. *Cape* Tenes	36 50	19 25	1 45 E
61. Oran	36 2	18 1	0 21 E
62. *Cape* de Tres Forcas . . .	35 30	15 31	2 9 W
63. Ceuta	35 54	12 50	4 50 W
64. *Tangier*	35 42	12 13	5 27 W
65. Tetuan	35 27	12 29	5 11 W

VII. ISLANDS within the STRAITS.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
1. ALBORAN	35 54	15 6	2 34 W
2. Formentura	38 33	19 30	1 50 E
3. Ivica	38 50	19 15	1 35 E
4. *Majorca*	39 30	20 38	2 58 E
5. *Minorca* City	39 51	22 27	4 47 E
6. C. Tolare } End of Sardinia	38 46	26 47	9 7 E
7. C.S. Reparde, N. } End of Sardinia	41 10	27 25	9 45 E

The MARINER'S SEA-COAST TABLE.

VII. ISLANDS within the STRAITS continued.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. ° ′
8. Port *Mahon*, Minorca . .	39 42	21 47	4 7 E
9. Galitta	37 41	26 19	8 39 E
10. *Sardinia*, S. End	38 46	26 47	9 7 E
11. Aſinaria	41 3	26 43	9 3 E
12. *Corſica*, S. End Bonifacio	41 24	27 21	9 41 E
13. *Corſica*, N. End Cape Corſo	42 56	27 25	9 45 E
14. Gorgona	43 34	27 13	9 33 E
15. Capraia, or Captia	43 3	28 2	10 22 E
16. Lilboa, or *Elba*	42 45	28 35	10 55 E
17. Planoſa	42 30	28 24	10 44 E
18. M. *Chriſto*	42 17	28 35	10 55 E
19. Palmarolla, or Palmeria . .	41 3	31 10	13 30 E
20. Ponſa	41 0	31 12	13 32 E
21. Iſchia	40 54	32 5	14 25 E
22. *Strombello*	38 58	33 35	15 55 E
23. Volcanello	38 27	33 8	15 28 E
24. Fellicur	38 30	32 35	14 55 E
25. Allicur	38 28	32 17	14 37 E
26. *Uſtica*	38 36	31 27	13 47 E
27. Trepano, W. End of Sicily	37 57	30 48	13 8 E
28. Palermo in *Sicily*	38 6	31 25	13 45 E
29. C. Paſſaro, W. End of *Sicily*	36 38	33 15	15 35 E
30. *Meſſina*, in *Sicily*	38 7	33 55	16 15 E
31. Maritimo	38 12	34 45	17 5 E
32. *Syracuſe*, in Sicily	37 3	33 20	15 40 E
33. C. Molin, in Sicily . . .	37 42	33 31	15 51 E
34. Cape Paſſaro	36 38	33 15	15 35 E
35. Pantalaria	36 48	29 55	12 15 E
36. Limoſa	35 56	30 46	13 6 E
37. Lampidoſa	35 34	30 21	12 41 E
38. *Malta**	35 54	32 9	14 29 E
39. *Ouvre l'oeil*, a Rock . .	35 45	34 11	16 31 E
40. *Grande*, or I. Longo . .	44 25	33 53	16 13 E
41. Poma	43 10	33 42	16 2 E
42. St. Andrea	43 11	34 1	16 21 E
43. Leſſa	43 6	34 15	16 35 E
44. Apoſta	42 58	34 55	17 15 E
45. Corzola	43 3	35 7	17 27 E
46. Melada	42 52	35 41	18 1 E
47. Corphu	39 42	37 41	20 1 E
48. Cephalonia	38 15	38 35	20 55 E
49. Zante	37 46	38 49	21 9 E
50. Sapienſa	36 40	39 20	21 40 E
51. *Rhodes City**	36 42	45 40	28 0 E

In the ARCHIPELAGO.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
52. *Taſſo*	40 40	42 52	25 12 E
53. *Lemnos*	39 59	43 12	25 32 E
54. *Metyline.* C. Sygre	39 15	43 40	26 0 E
55. *Metyline.* P. Oliva	38 57	44 15	26 55 E
56. Sciatto, or Schate	39 22	41 33	23 53 E
57. *Scio* or Xio	38 22	43 47	26 7 E
58. *Patmos*	37 20	44 30	26 50 E
59. Zino	37 35	43 11	25 31 E
60. Zio, or Sea	37 37	42 25	24 45 E
61. Fermina	37 24	42 33	24 53 E
62. Sifanto, or Sorfante	36 58	42 55	25 15 E
63. Millo, Mila, or Melo	36 40	42 35	24 55 E
64. W End of *Candia.* C. St. John	35 15	41 35	23 55 E
65. E End of *Candia.* C. Solomon	35 0	44 43	27 3 E
66. Rhodes N End / S End	36 27	46 13	28 33 E
67. C. *Tranquil*	36 1	46 3	28 23 E
68. SW End of *Cyprus* C. Baffa	34 57	49 58	32 18 E
69. E End of *Cyprus* C. St. Andrea	35 31	52 35	34 55 E
70. S End of *Cyprus* C. de Gatte	34 30	50 45	33 5 E

VIII. COAST of BARBARY and GUINEA.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
1. CAPE SPARTEL	35 50	11 46	5 54 W
2. Salle	33 51	10 10	6 30 W
3. Cape Cantin	32 36	8 25	9 15 W
4. Cape de Geer	30 27	7 29	10 11 W
5. Cape de Non	28 15	6 31	11 9 W
6. Cape Bajadore	26 4	2 0	15 40 W
7. Cape Olciado	23 41	1 40	16 0 W
8. Cape *Blanco*	20 32	0 0	17 40 W
9. Senegal	15 28	1 5	16 35 W
10. Cape *de Verd**	14 43	0 30	17 10 W
11. Mouth of River *Gambia* . . .	13 8	2 4	15 36 W
12. *Sierra Leona*	8 36	4 38	13 2 W
13. Cape *de Monte* or Mount . .	6 23	5 35	12 5 W
14. Monferado	6 5	7 33	10 7 W
15. River Seſter or Seſtos	5 24	8 59	8 41 W
16. Cape de *Palmas*	4 13	10 50	6 50 W
17. River St. Andrea	5 5	13 20	4 20 W
18. Cape 3 Points	4 28	15 45	1 55 W
19. Jaque Jaque	4 16	7 48	9 52 W
20. Aſſene	4 15	10 18	7 22 W
21. Cape Corſe	4 55	19 35	1 55 E
22. River de *Volta*, or *Accara* . .	5 55	21 0	3 20 E
23. River Formoſa	7 0	24 15	6 35 E
24. Cape Formoſa	4 15	24 15	6 35 E
25. New *Calabar* Ent.	4 42	26 8	8 28 E
26. Old Calabar Ent.	4 10	27 20	9 40 E
27. River Camerones	3 25	27 45	10 5 E
28. River Angra	0 50	27 36	9 56 E

Places Names.	Lat. S. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. or W. ° ′
29. Cape Lopas	0 55	27 30	9 50 E
30. Cape Negro	16 8	30 6	12 26 E
31. River Congo	5 40	33 0	15 20 E
32. Angola	8 57	33 31	15 51 E
33. Cape St. Thomas	24 10	32 18	14 38 E
34. Cape Secos, Sego, or Seca . .	29 0	33 31	15 51 E
35. Cape of *Good Hope**	34 15	34 40	17 0 E
36. Cape Aguilhas or Lagullas . .	34 54	38 55	21 15 E

IX. The WESTERN ISLANDS.

	N. ° ′	° ′	° ′
1. CORVO	39 54	346 40	31 0 W
2. Flores (*Azores*)	32 32	346 41	30 59 W
3. Fyal	38 53	349 20	28 20 W
4. Pico	38 40	350 15	27 25 W
5. St. *George*	38 52	351 32	26 8 W
6. Tercera	38 57	352 1	25 39 W
7. Gratioſa	39 16	350 34	27 6 W
8. Whale Fiſh	39 37	352 24	25 16 W
9. Vajo, or Vejia	38 43	353 47	23 53 W
10. St. Michael	38 6	353 59	23 41 W
11. Formigas, or Hormigas	37 40	354 48	22 52 W
12. St. Mary's	36 59	353 57	23 43 W

X. CANARY ISLANDS.

	N. ° ′	° ′	° ′
1. SANCTO Porto	32 58	1 41	15 59 W
2. *Maderia* W. End	32 23	0 9	17 31 W
3. Salvages	30 0	0 45	16 55 W
4. Palma	28 40	359 59	17 41 W
5. FERRO*	27 54	0 0	17 40 W
6. Gomero	28 6	0 30	17 10 W
7. Pico Tenerif	28 23	0 7	16 33 W
8. Grand Canary	27 52	1 25	15 15 W
9. Allegranſa	29 20	5 2	12 38 W
10. Lancerota	29 2	4 50	12 50 W
11. Forteventura, S. W. End	28 5	3 59	13 41 W

XI. CAPE DE VERD ISLANDS.

	N. ° ′	° ′	° ′
1. St. ANTONIO	17 24	352 33	25 7 W
2. St. Vincent	17 4	352 56	24 44 W
3. St. *Lucia*, or round Iſland	17 5	352 55	24 45 W
4. St. Nicholas	16 50	353 37	24 3 W
5. Iſle *de Sal*	16 50	355 27	22 13 W

The MARINER'S SEA-COAST TABLE.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr* E. or W.
XI. CAPE DE VERD ISLANDS continued.			
	° ′	° ′	° ′
6. Bonavista	16 5	355 28	22 12 W
7. Mayo, or Island *May* . . .	15 14	355 33	22 7 W
8. St. Jago	15 8	354 39	23 1 W
9. Fuego, or Fulgo	14 50	353 54	23 46 W
10. Bravas	14 28	353 33	24 7 W
11. St. *Paul*	1 20	352 5	25 35 W
XII. SOUTHERN ISLANDS.			
	N. ° ′	° ′	° ′
1. Fernande Poo	2 40	28 5	10 25 E
2. De *Prince*	1 40	26 50	9 10 E
3. St. Thomas	0 0	25 55	8 15 E
	S.		
4. St. Matthews	1 30	11 34	6 6 W
5. Annabona	2 10	25 2	7 22 E
6. *Ascension*	7 20	4 30	13 10 W
7. St. *Helena* Nova	16 0	23 49	6 9 E
8. St. *Helena**	15 56	12 25	4 15 W
9. Tristian de Acuntia . . .	37 5	3 45	13 55 W
XIII. Main CONTINENT in the EAST INDIES.			
	S. ° ′	° ′	° ′
1. Bay de Allogo or Dallagoa	25 30	48 40	31 0 E
2. River St. *Lucia*	28 20	49 52	32 12 E
3. Cape St. *Martin* or *Mary*	22 40	52 40	35 0 E
4. Cape *Corientes*	23 40	53 52	36 12 E
5. Mosambique	15 4	58 45	41 5 E
6. P. de Aguada, or Del *Gada*	10 17	57 45	40 5 E
7. Cape de *Falso*	9 0	56 55	39 15 E
8. Tongon	4 50	56 34	38 54 E
9. Mombaso	3 50	56 5	38 25 E
10. Molinde, or Melinde . .	2 58	57 10	39 30 E
11. River *Lamos*	1 20	57 48	40 8 E
12. River de *Fuego*	0 41	58 50	41 10 E
	N.		
13. Magadoxa	2 20	62 25	44 45 E
14. Cape de *Bassas*, or Boxos . .	4 6	65 13	47 33 E
15. Cape Gardefoy	11 44	68 55	51 15 E
16. Aden	13 0	64 35	46 55 E
17. *Mocha*	14 10	62 25	44 45 E
18. Cape *Matriaca*	15 23	69 45	52 5 E
19. Defar	17 0	73 10	55 30 E
20. Cape Resulgat	22 41	77 20	59 40 E
21. Cape *Muca*, or Muscat . . .	23 32	77 20	59 40 E
22. Busero	29 45	66 55	49 15 E
23. *Gombaroon*	27 20	74 15	56 35 E

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E.
	° ′	° ′	° ′
24. *Cape* Glado	25 50	81 9	63 29 E
25. River de *Sinda*	24 55	85 10	67 30 E
26. *Diu* Head	21 2	87 25	69 45 E
27. *Surat**	21 10	90 0	72 20 E
28. Deman	20 6	91 5	73 25 E
29. *Bombay* Island	19 18	90 41	73 1 E
30. St. John's	19 55	90 55	73 15 E
31. Chaul, or Choale . . .	18 31	91 12	73 32 E
32. Dabul	18 3	91 35	73 55 E
33. Rajapour Isle	17 2	91 45	74 5 E
34. *Goa**	15 31	91 25	73 45 E
35. Carwar	14 47	92 35	74 55 E
36. Manquelore	12 53	93 0	75 20 E
37. Tellecherry	11 42	93 0	75 20 E
38. Callecut	11 16	93 5	75 25 E
39. Cannanou	10 22	93 10	75 30 E
40. Cochin	9 54	93 30	75 50 E
41. Anjanga	8 29	94 0	76 20 E
42. Cape Comerin	7 50	95 0	77 20 E
43. Colombo, in *Zeylon* . . .	7 7	97 5	79 25 E
44. Point de Galle, or Gallo, on the same	6 10	97 45	80 5 E
45. *Dunder-Head*, on the same	6 2	98 28	80 40 E
46. Trinconomale	8 40	99 15	81 35 E
47. Great Bassas Shoals . . .	6 23	99 20	81 40 E
48. Jetrapatam	9 50	97 40	80 0 E
49. Negrapatam	11 1	97 30	79 50 E
50. Trincumbar	11 15	97 25	79 45 E
51. Porta Nova	11 45	97 19	79 39 E
52. *Pondicherry**	11 54	97 53	80 13 E
53. Fort St. David, or *Tregapatam*	12 5	97 23	79 43 E
54. Congmere	12 35	97 40	80 0 E
55. Fort St. *George* or *Madrassapatam*	13 11	98 7	80 27 E
56. Pullicat	13 30	97 57	80 17 E
57. Armegon	14 16	97 47	80 7 E
58. Petapoly	16 6	98 17	80 37 E
59. Diu Point, or *Mecha* . . .	16 8	99 7	81 27 E
60. Masulapatam	16 22	98 45	81 5 E
61. Massipore	16 30	99 32	81 52 E
62. Visagapatam	17 43	101 32	83 52 E
63. Birmlapatam	17 51	101 44	84 4 E
64. Pondy	18 49	102 50	85 10 E
65. Jacarnaut *Pagod*	19 51	104 17	86 37 E
66. Arsipare	29 11	104 58	87 18 E
67. Point *Palmiras*	20 42	105 27	87 47 E
68. *Balasore* Road	21 16	105 23	87 43 E
69. Pipley	21 25	105 32	87 52 E
70. Hughly	23 9	106 40	89 0 E
71. Dacca	23 57	108 30	90 50 E
72. Casimbazar	25 6	106 20	88 40 E
73. River *Bengal*	22 17	109 56	92 16 E
74. River Aracan	20 10	111 15	93 35 E
75. *Pegu*	18 35	113 55	96 15 E
76. *Malacca**	1 16	119 45	102 5 E
77. Formosa	2 5	119 5	101 25 E

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E.
	° ′	° ′	° ′
78. Point *Romania*	1 16	120 50	103 10 E
79. Point *Cai*	12 10	116 37	98 57 E
80. Siam *Entrance*	14 18	118 30	100 50 E
81. Camboida *Entrance* . . .	10 28	122 35	104 55 E
82. Cape Anarilla, or Avarilla	13 25	125 38	107 58 E
83. Cochin, or Chinchen	14 5	125 31	107 51 E
84. *Macao**	22 13	131 26	113 46 E
85. Tonquin	20 50	123 15	105 35 E
86. *Canton**	23 8	130 43	113 3 E
87. Amoy, or Quemoy Island	24 35	134 25	116 45 E
88. Hocksew	26 30	135 55	118 15 E
89. River *Swadia*	27 51	136 25	118 45 E
90. Liampo, Lingpo, or Ningpo	29 59	138 10	120 30 E
91. Island Chusan	30 0	138 10	120 30 E
92. Nanquin*	33 45	137 36	119 56 E
93. Pekin*	39 54	134 3	116 23 E
XIV. ISLANDS in the EAST INDIES.			
	S. ° ′	° ′	° ′
1. St. Paul	38 20	93 0	75 20 E
2. Amsterdam Isle	38 40	90 15	72 35 E
3. *Romeras* de Castle-lamas	28 45	94 52	67 12 E
4. St. Joan de *Lisbon*	25 24	71 5	53 25 E
5. *Diego Roys*	19 50	79 5	61 25 E
6. St. Brandon	16 38	82 5	64 25 E
7. Mauritius	20 10	70 30	52 50 E
8. Malha	11 15	78 5	60 25 E
9. C. St. Mary, S. End of Madagascar.	25 47	60 45	46 5 E
10. C. D'Ambre, N.	12 10	68 40	51 0 E
11. Terra del Madagas	19 29	62 10	44 30 E
12. St. John de Nova	17 21	60 55	43 15 E
13. St. Christova	17 36	61 15	43 35 E
14. Mayetto	13 10	63 13	45 33 E
15. Joanna	12 10	62 38	44 58 E
16. Mohilla	12 5	61 58	44 18 E
17. Comero, or Angazecha	11 40	61 25	43 45 E
18. Morsia or *Monsia*	8 7	57 50	40 10 E
19. *Zanzebar*	6 48	57 32	39 52 E
20. Penda	5 20	57 10	39 30 E
21. *Comero*	10 30	62 14	44 34 E
22. Cosmedelo	10 14	68 52	51 12
23. Juan de *Nova*	9 30	70 16	52 36 E
24. Astore Isle	9 55	71 25	53 45 E
25. Agalega, or Gallega	9 47	72 6	54 26 E
26. Setta Harmanes	2 47	76 48	59 8 E

The MARINER'S SEA-COAST TABLE.

Places Names.	Lat. S.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E.
XIV. ISLANDS in the EAST INDIES Continued.			
	° '	° '	° '
27. Quevelo, Quebello	3 53	70 11	52 31 E
28. Baffas de Banhas	5 5	66 21	48 41 E
29. Hermanos	3 32	72 20	54 40 E
30. Ifle *Gratio*	6 10	80 36	62 56 E
31. Padra Banhas	2 10	83 7	65 27 E
32. Baffas de *Chages*, or Ifland *Chago*	6 55	86 20	68 40 E
33. Diego *Gratiofa*	8 40	86 0	68 20 E
34. Three *Germans*	4 30	80 18	62 38 E
35. *Crofs*-Ifland	4 10	75 40	58 0 E
	N.		
36. Yas de Amber	0 0	70 5	52 25 E
37. Sacatora, or Zucatora . .	12 21	71 40	54 0 E
38. Abdeleur If.	12 4	70 29	52 49 E
39. Cubello . . .	8 10	89 20	71 40 E
40. Malique	9 0	90 33	72 53 E
41. Garipe, or Grife	10 40	90 12	72 32 E
42. Qualpera	10 0	91 5	73 25 E
43. Andomaon, or Antada . . .	11 10	91 7	73 27 E
44. *Ceylon*, S. End, or C. Gallo	6 8	98 50	81 10 E
45. *Maldivias* S Part	0 25	93 57	76 17 E
46. *Maldivias* N Part	7 14	90 39	72 59 E
47. *Yas* de Diego Reys	0 20	89 35	71 55 E
48. *Manila*	14 25	134 41	117 1 E
49. *Aynian* NW Part	19 30	124 35	106 55 E
50. *Aynian* N E Part	19 55	127 30	109 50 E
51. *Japan* S E Part	35 30	158 5	140 25 E
52. *Japan* SW Part	35 0	146 5	128 25 E
53. Verkin's Ifland	2 22	111 42	94 2 E
54. Cocos	4 10	108 37	90 57 E
55. Andaman . .	12 35	109 54	92 14 E
56. *Borneo* . . .	4 50	128 30	110 50 E
57. Nicobar . . .	7 11	111 15	93 35 E
58. *Sumatra*, N.W. End	5 22	112 25	94 45 E
	S.		
59. *Bencola* . . .	3 55	121 43	104 3 E
60. *Sumatra*, S. E. End	5 22	122 45	105 5 E
61. Jambe	1 19	120 30	102 50 E
62. *Bantam*	6 11	123 30	105 50 E
63. *Batavia*	6 16	124 21	106 41 E
64. *Naffau* Ifland	2 54	117 7	99 27 E
65. Engano, or Trompeus . .	5 50	119 18	101 38 E
66. Selam	8 20	119 48	102 8 E
67. Princes Ifland	6 30	121 37	103 57 E
68. *Java*, E. End	8 32	131 5	113 25 E
69. Straits of *Sundy*	6 2	123 21	105 41 E
70. *Banca*, S. End	3 20	124 20	106 40 E
71. Borneo, South Point	3 54	131 12	113 32 E
72. Banda Ifles	4 55	144 52	127 12 E
73. Celebes, S. End	5 10	136 42	119 2 E

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E. or W.
	° '	° '	° '
74. Celebes, N. End	1 40	139 55	121 15 E
75. Meridano, W. Part	6 40	136 50	119 10 E
76. *Borneo*, N. Part	7 40	130 40	113 0 E
77. *Leuconia* SW Pt	12 30	137 45	120 5 E
78. *Leuconia* N E Pt	18 55	137 40	120 0 E
79. *Formofa* S. Part	22 0	137 31	119 51 E
80. *Formofa* N. Part	25 30	138 20	120 40 E
81. *Pifcadore* Iflands	23 30	136 10	118 30 E
XV. COAST of AMERICA *in the* SOUTH-SEA, from *California* to CAPE-HORN.			
	N. ° '	° '	° '
1. Cape St. Sebastian . .	42 45	249 40	128 0W
2. Cape St. Lucas, or *Lucia* . . .	23 20	265 49	111 51W
3. *Cape* Corientes	18 50	267 5	110 35W
4. *Aquapulco*	17 5	273 17	104 23W
5. Aquatulco	15 27	275 32	102 8W
6. Guatimala	14 25	276 35	101 5W
7. Panama	8 50	295 43	81 57W
8. Bay Bonaventure . . .	3 24	299 29	78 11W
9. Ifland Gallopega . . .	0 0	287 25	90 15W
	S.		
10. Cape de Adjugo	6 30	292 45	84 55W
11. *Lima**	12 1	300 51	76 49W
12. Arica	18 29	304 25	73 15W
13. La *Serena*	29 0	301 13	76 27W
14. Ifl. Juan *Fernandes* . .	33 15	289 17	88 23W
15. *Baldivia*	39 35	296 25	81 15W
16. Port *Steven*	46 50	294 59	82 41W
17. Cape *Victory*	52 0	294 25	83 15W
18. Cape *Horn*, S. Part Terra del Fuego	56 55	297 40	80 0W
XVI. COAST of BRASIL in *South America*, from *Cape* HORN to *Cape* ROQUE.			
	S. ° '	° '	° '
1. Le Maire Straits	54 34	304 34	73 6W
2. Cape Virgin Mary of Magellan Straits . .	52 0	302 30	75 10W
3. Point of River *Julian* . .	48 40	303 1	74 39W
4. Pepy's Ifles	47 20	310 55	66 45W
5. Cape *Blanco*	46 50	305 28	72 12W
6. River Camerones . . .	45 30	304 35	73 5W
7. Point de los Leones . . .	44 0	306 55	70 45W
8. Bay *Siffendo*	42 35	319 35	53 5W
9. Cape St. Andreas . .	38 40	314 30	63 10W
10. River *Plate*	35 40	319 59	57 41W
11. *Buenos Ayres** in River Plate	34 35	319 35	58 5W
12. Cape St. *Maria*	34 30	320 55	56 45W

Places Names.	Lat. S.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* W.
	° '	° '	° '
13. River Grande Entrance	31 55	325 35	52 5W
14. Ifl. St. *Catherine*	27 5	328 35	49 5W
15. Cape *Frio*	23 0	335 15	42 25W
16. Cape St. *Thomas*	22 10	335 20	42 20W
17. *Spirito Sancto*	19 59	335 25	42 15W
18. Cape de *Abrolhos*	18 15	336 28	41 12W
19. Port *Segura*	16 31	337 0	40 40W
20. Bay *Todos Sanctos* . . .	12 46	336 35	41 5W
21. River St. *Francifco* . . .	10 50	339 45	37 55W
22. *Olinda*,* or Pernambuco	8 13	342 30	35 10W
23. Cape St. *Auguftin*	8 35	342 15	35 25W
24. *Rio* Grande	5 20	341 38	36 2W
25. Cape *Roque*	5 0	341 48	35 52W
26. Ifland Ferdinando Lorenha	3 50	346 25	31 15W
27. Para River	2 50	334 48	42 52W
28. Ifland St. *Paul*	1 20	352 5	25 35W
29. Ifl. Trinidada	20 30	347 35	30 5W
30. Ifl. *dos Picos*	22 30	352 20	25 20W
31. Ifl. de Martinvas . . .	19 30	350 40	27 0W
32. Ifl. St. *Maria* de *Agofta* . .	19 40	348 25	29 15W
33. Ifl. Afcenfion	7 40	3 10	14 30W
XVII. COAST *of the Main* CONTINENT *in the* WEST INDIES.			
	N. ° '	° '	° '
1. River Amazon's Mouth	0 0	327 39	50 1W
2. Cape *Orange*	4 25	326 10	51 30W
3. Suranam	6 25	320 45	56 55W
4. N. Cape, the Middle of *Caopory* Ifl. . .	2 5	327 39	50 1W
5. Cape *Naffau*	8 5	319 40	58 0W
6. Cape 3 Points	10 30	315 25	62 15W
7. Mouth of *Oronoque* River	8 15	318 10	59 30W
8. Ifl. *Trinidada*	10 15	317 18	60 22W
9. Ifl. Margarita	11 20	314 15	63 25W
10. Ifl. Curafoe, or Quicafoe . .	12 10	309 40	68 20W
11. Cape Conquinbaco . . .	12 40	306 53	70 47W
12. *Cartagena**	10 27	302 14	75 26W
13. *Darien*, or Scots Settlement	8 30	298 50	78 50W
14. *Porto Bello**	9 33	297 50	79 50W
15. *Nicaragua* Entrance . .	11 25	293 20	84 20W
16. Cape *Camaron*	16 10	294 5	83 35W
17. Cape *Honduras*	16 25	292 50	84 50W
18. Salamancha	16 50	288 25	89 15W
19. Cape *Catocha*	21 10	291 25	86 15W
20. *Cape* Condefedo . . .	20 40	287 55	89 45W
21. *Campecha*	19 30	285 25	92 15W
22. Trifte, or Trieft Ifles . . .	18 10	286 15	91 25W

The

The MARINER'S SEA-COAST TABLE.

XVII. COAST *of the Main* CONTINENT *in the* WEST-INDIES continued.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* W.
	° ′	° ′	° ′
23. Sierra, or Cape de Martin	19 10	181 50	95 50W
24. *La Vera Cruz*	19 12	279 45	97 55W
25. *Mexico**	20 0	274 0	103 40W
26. Tompeck	22 20	277 20	100 20W
27. River *Spiritus Sanctus*, or Missisippi River's Mouth	28 54	280 45	96 55W
28. *La Phillipina*, or *Apalachia*	29 47	292 51	84 49W
29. Cape *Florida*	24 57	297 5	80 35W
30. Escondido	30 20	288 5	89 35W
31. Bay Hondy	22 45	293 55	83 45W
32. Cape St. Antonio	21 45	292 3	85 37W
38. Aruba	12 50	309 7	68 33W
39. E. End of *Hispaniola*	18 18	308 20	69 20W
40. St. *Domingo*, in Hispaniola	18 25	308 5	69 35W
41. W. End of Hispaniola	18 26	302 59	74 41W
42. East End of Jamaica	18 0	301 45	75 55W
43. Port Royal in *Jamaica*	17 40	301 3	76 37W
44. West End of Jamaica	18 8	298 35	79 5W
45. East End of *Cuba*	20 15	303 40	74 0W
46. *Havanna*	22 40	294 40	83 0W
47. West End of *Cuba*	21 40	291 5	86 35W
32. St. *Andreo*	12 23	297 18	80 22W
33. Caimanuback	19 8	297 24	80 16W
34. *Pedro* Shoals, N. Side	17 10	299 39	78 1W
35. St. Milan	17 10	296 7	81 33W
36. *Guayna*	16 53	289 5	88 35W
37. Cozumelli	19 30	288 30	89 10W
38. *Zuna* Quita	17 1	287 47	89 53W

XVIII. CARIBBEE ISLANDS.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* W.
	° ′	° ′	° ′
1. TRINIDADA	10 15	317 18	60 22W
2. Tobago, West End	11 10	318 25	59 15W
3. *Barbadoes*, at Bridge-Town	12 58	318 45	58 55W
4. Granado	11 57	317 15	60 25W
5. Granadillos	12 20	317 40	60 0W
6. Boquia	12 50	317 42	59 58W
7. St. *Vincent*	13 12	317 23	60 17W
8. St. *Lucia*	13 55	317 31	60 9W
9. *Martinico**	14 43	316 41	60 59W
10. *Dominico*	15 23	317 5	60 35W
11. *Marigallante*	15 58	317 15	60 25W
12. *Guadalupe*	16 10	316 20	61 20W
13. *Deseada*	16 20	316 25	60 15W
14. *Antigua*	17 5	315 50	61 50W
15. *Barbuda*	17 56	316 55	60 45W
16. *Monserat*	16 45	315 20	62 20W
17. *Rodunda*	16 55	316 20	61 20W
18. *Nevis*	17 5	315 3	62 37W
19. St *Christopher's*	17 17	314 55	62 45W
20. *Eustatia*	17 25	314 15	62 25W
21. *Saba*	17 35	314 55	62 45W
22. St. *Bartholomew*	17 52	315 29	62 11W
23. St. *Martin's*	18 6	315 25	62 15W
24. *Anguilla*	18 17	315 22	62 18W
25. *Sombrero*	18 35	315 5	62 35W
26. *Anegada*	18 47	314 49	62 51W
27. St. *Cruise*	17 52	314 5	63 35W
28. *Virgins*	18 30	314 10	63 30W
29. St. *Thomas*	18 30	314 13	63 27W
30. St. *John de Port Rico*	18 30	311 58	65 42W
31. *Isles and Rocks of Aves*	12 1	313 5	64 35W
32. *Tortuga*	11 10	313 41	63 59W
33. *Margaritta*	11 20	314 15	63 25W
34. Blanco	11 50	313 55	63 45W
35. Testigos	11 35	314 54	62 46W
36. D'Orchila	11 45	313 5	64 35W
37. *Bonairy*	12 12	311 7	66 33W

XIX. BAHAMA ISLANDS.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* W.
	° ′	° ′	° ′
1. BERMUDAS	32 25	313 55	63 45W
2. North Part of *Bahama* Bank	27 50	299 0	78 40W
3. *Bahama* Island	26 50	298 19	79 21W
4. Abaco, South End	26 0	303 49	73 51W
5. Harbour Island	25 37	300 48	76 52W
6. Andros, North End	25 10	298 55	78 45W
7. *Providence*	25 0	300 15	77 25W
8. *Eleuthera*, South End	24 40	301 39	76 1W
9. Cat Island, Middle	24 25	302 26	75 14W
10. *Watling's* Island	24 3	303 0	74 40W
11. Rum-Key	23 45	302 45	74 55W
12. *Exuma*	23 22	307 40	76 0W
13. Crooked Isl. N. End	22 56	303 23	74 17W
14. Long Isl. South End	22 41	302 53	74 57W
15. Atwood's Keys	23 10	304 0	73 40W
16. *Mayaguana*	22 35	303 49	72 51W
17. French Keys	22 40	303 55	73 45W
18. Marapervouz	21 58	302 50	74 50W
19. Hogsties	21 17	303 40	74 0W
20. *Hineago*, West End	20 52	303 49	73 51W
21. West Caicos	21 38	305 37	72 3W
22. *Caicos*, North End	20 50	306 15	71 25W
23. Turks Isl.	21 35	307 27	70 13W
24. Abrolho Bank, N. End	21 35	308 29	69 11W
25. Plate Wreck	20 10	309 20	68 20W
26. *Mucares*	21 30	301 0	76 40W
27. Verd	21 17	301 19	76 21W
28. Cajad Zal	23 10	297 11	79 29W
29. *Pinos*	21 20	293 25	84 25W
30. Great Camains	18 54	296 6	81 34W
31. Little Camains	19 30	297 11	80 29W

XX. COAST of CAROLINA, VIRGINIA, MARYLAND, PENSILVANIA, NEW ENGLAND, and NEWFOUNDLAND.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* W.
	° ′	° ′	° ′
1. BAY of St. AUGUSTINE	30 10	296 52	80 48W
2. Port Royal	32 0	297 52	79 48W
3. *Charles* Town, upon Ashley River	33 5	298 49	78 51W
4. Cape Roman or Cartit	33 27	299 45	77 55W
5. Cape Fear	33 58	300 41	76 59W
6. Cape *Hatteras*	35 15	303 15	74 25W
7. Cape *Henry*	37 0	302 11	75 29W
8. Cape *Charles*	37 16	303 19	74 21W
9. Cape *May*	39 6	303 56	73 44W
10. Cape Henlopen, or Cape James	38 50	302 39	75 1W
11. Long Island, Middle	40 50	304 50	72 50W
12. Sundy-Hook	40 25	303 41	73 59W
13. New York	40 58	303 42	73 58W
14. Fisher's Islands	41 20	306 55	70 45W
15. Montock Point	41 18	307 15	70 25W
16. *Block* Island	41 15	307 37	70 3W
17. Elizabeth's Island	41 35	308 22	69 18W
18. *Martha's* Vineyard	41 14	308 26	69 14W
19. Nantucket Island	41 15	308 47	68 53W
20. S. End of Nantucket Shoals	39 50	309 17	68 23W
21. South End of St. George's Bank	41 55	310 25	67 15W
22. *Plymouth*	42 2	308 45	68 55W
23. Boston Entrance	42 30	308 12	69 28W
24. Cape Cod	42 12	308 40	69 0W
25. Cape *Ann* Island	42 46	307 50	69 50W
26. Pascataway Entrance	43 26	307 25	70 15W
27. North Yarmouth	44 14	309 37	68 3W
28. Panobscot River	44 40	310 25	67 15W
29. Point, or Port Royal	44 45	311 55	65 45W
30. Cape Sable	43 50	312 37	65 3W
31. Island Sable	44 20	318 34	59 6W
32. Cape *Breton*	46 0	319 5	58 35W
33. Cape *Charles*, or Chr. Straits	52 10	323 35	55 5W
34. Anti Costi Isl. the Middle	49 40	316 50	60 50W

The MARINER'S SEA-COAST TABLE.

XX. COAST of CAROLINA, VIRGINIA, MARYLAND, PENSILVANIA, NEW ENGLAND, and NEWFOUNDLAND, continued.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* W. ° ′
35. *Quebeck**	46 55	307 47	69 53W
36. Tadousack	49 0	310 30	67 10W
37. Bay of *Brest*	52 10	320 38	57 2W
38. Bell-Island	52 7	322 0	55 40W
39. Cape St. *John*	50 25	324 47	52 53W
40. Cape *Bonavista*	49 15	325 23	52 17W
41. French Factory	50 10	316 25	61 15W
42. *Virgin* Rocks	46 0	319 55	57 45W
43. Cape Roye	48 0	319 55	57 45W
44. Isl. St. *Paul*	47 10	319 17	58 23W
45. Cape St. Laurensa . .	47 30	323 12	54 28W
46. *Placentia* Bay	47 45	323 37	54 3W
47. Cape St. *Mary*	47 10	324 12	53 28W
48. St. John's Harbour . . .	48 0	325 56	51 44W
49. Bay of *Bulls*	47 50	316 6	51 34W
50. Cape Race	46 40	325 43	51 57W
51. Cape St. Francis . . .	48 9	325 49	51 51W
52. Conception Bay Entrance	48 20	325 27	52 13W
53. Barcaleau Isl.	48 40	325 39	52 1W
54. Trinity Bay Entrance . .	48 52	325 15	52 25W
55. *Penguin* Isl.	50 0	324 45	52 55W
56. Grey's Isl.	50 35	324 10	53 30W

XXI. COAST of HUDSON'S BAY, and the STRAITS.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* W. or E. ° ′
1. BUTTON'S ISLES . . .	60 25	311 8	66 32W
2. *Cape* Charles	62 10	302 0	75 40W
3. *Cape* Walsingham . . .	62 35	299 40	78 0W
4. *Cape* Jones	54 55	298 37	79 3W
5. Mansfeld Isl. the Middle	61 42	297 5	80 35W
6. Sleeper's Isles	60 10	296 5	81 35W
7. Baker's Dozen Isles . . .	57 56	296 10	81 30W
8. Bears-Isles	54 25	293 50	83 50W
9. *Cubbs*-Isle	54 10	294 55	82 45W
10. *Weston*'s Isl.	52 58	294 47	82 53W
11. Solomon's Temple Island	53 5	296 35	81 5W
12. Shepherd's Isl.	51 45	296 47	80 53W
13. Danby's Island	52 15	295 39	81 1W
14. Charlton's Island	52 8	285 15	81 25W
15. *Rupert*'s River	51 30	298 9	79 31W
16. Frenchman's River . .	51 20	297 21	80 19W
17. Point Comfort	51 24	296 24	81 16W
18. Mouse River's Mouth . .	51 18	294 22	83 18W
19. *Albany Fort*	52 26	292 45	84 55W
20. Viner's Isl.	53 5	293 32	84 8W
21. *Cape* Henrietta Maria . . .	55 7	293 5	84 35W
22. New *Severn*	56 0	289 15	88 25W
23. Port Nelson, or York Fort . .	57 10	283 37	94 3W
24. *Cape Churchill*	59 0	282 15	95 25W
25. Sir Thomas Roe's *Welcome*	64 15	285 31	92 9W
26. *Cape* Southampton	61 55	290 47	86 53W
27. Shark *Point*	64 30	294 40	83 0W
28. *Nottingham* Isl.	63 30	297 42	79 58W
29. *Mills* Isles	64 26	297 17	80 23W
30. Salisbury Island	63 45	300 20	77 20W
31. Salvages Island	62 40	307 18	70 22W
32. Qu. *Ann*'s Foreland	63 48	302 50	74 50W
33. Resolution Isle	61 50	312 31	65 9W
34. *Cape Elizabeth*	62 3	310 45	66 55W
35. *Cape Farewell*	59 45	330 50	46 50W

XXII. COAST of ICELAND, GREENLAND, NOVA ZEMBLA, and the NORTHERN ISLES.

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* W. or E. ° ′
1. SOUND ROYAL	66 22	353 2	24 38W
2. Bargarer's Point	66 20	1 0	16 40W
3. *Whale*'s Bay	65 27	357 2	20 38W
4. Grime's Hole, or Guberman's Rocks	66 23	348 5	29 35W
5. *Gamar* Isles, or Gille	65 48	350 41	26 59W
6. *Westmania* Isles	63 30	354 41	22 59W
7. Rook-Point	64 0	351 11	26 29W
8. *Halliford*	64 30	342 52	34 48W
9. *Snow-Hill*	65 11	350 21	27 19W
10. Fair Foreland	66 20	351 8	26 32W
11. Roge Point, or *Orgel* Bay . .	66 0	352 10	25 30W
12. *Marza*, or Langeness	66 8	353 35	24 5W
13. Grims Isl.	67 15	355 1	22 39W
14. Isles of *Ferro*	62 6	12 35	5 5W
15. *Langeness*	66 46	4 45	12 55W
16. *Silly*, or Pappy Isl.	64 50	5 25	12 15W
17. *Horn Bay*	64 50	5 35	12 5W
18. *Merchant*'s Foreland	63 25	0 30	17 10W
19. *Portland*	64 2	356 30	21 10W
20. Green's Island	66 50	352 55	24 45W
21. *Beerenbergh*, or *John Main*'s Island	71 45	22 5	4 25 E
22. *Hacluit*'s Head Hand	79 55	28 35	10 55 E
23. Fair *Foreland*	79 20	28 27	10 47 E
24. *Cape* Cold, N. End of *Charles* Isl.	79 0	27 35	9 55 E

Places Names.	Lat. N. ° ′	Long. fr. *Ferro.* ° ′	D. Long. fr. *Gr.* E. ° ′
25. Black Point, or South End of Charles Isle	78 0	28 5	10 25 E
26. Deer *Sound*	79 15	30 15	12 35 E
27. Fowl *Sound*	77 25	30 25	12 45 E
28. Bell *Sound*	77 15	30 15	12 35 E
29. Horn *Sound*	76 45	31 11	13 31 E
30. Point *Lookout*	76 25	33 11	15 31 E
31. *Helie*'s Sound	78 55	39 25	21 45 E
32. *Cape Barcan*, or Barcam . . .	78 15	39 46	22 6 E
33. *Cape Blanco* } Hope Isl.	77 45	41 5	22 25 E
34. *Duck's Cove* } Hope Isl.	77 35	40 45	23 5 E
35. *Negro Point* } Hope Isl.	76 55	41 5	23 25 E
36. *Hope* Island	76 18	41 20	23 40 E
37. Whale's Head	77 18	39 [illegible]	21 25 E
38. Lee's Foreland	78 5	41 [illegible]	23 20 E
39. Cherry, or Bear Island	74 30	35 43	18 3 E
40. Ice Point, or *Cape Desire*	77 40	86 45	69 5 E
41. *Admiralty-Island*	75 5	77 25	59 45 E
42. *Langeness*	74 20	71 11	53 31 E
43. *Cross*-Point	72 0	70 47	53 7 E
44. Fretumborough	70 0	78 55	61 15 E
45. Colgoyen Isl.	69 0	62 35	44 55 E
46. *Cape Candynose*	69 5	60 10	42 30 E
47. *Cape* Barso	66 30	55 35	37 55 E
48. *Catnose*	65 43	52 49	35 9 E
49. *Archangel*	64 30	58 5	40 25 E
50. *Cross-Island*	66 31	54 8	36 28 E
51. *Cape* Gallant, or Sweet-Nose	68 10	52 20	34 40 E
52. Kilduyn Isl.	69 30	48 55	31 15 E
53. River *Kola*, Entrance	69 10	48 40	31 0 E
54. Fisher's Island	70 0	44 15	26 33 E
55. *North Cape*	71 23	40 37	22 57 E
56. Surroy Island	71 5	34 15	16 35 E
57. Tromsound Isl.	70 25	33 5	15 25 E
58. Isl. Sanien, S. W. Point . .	69 35	30 35	12 55 E
59. *Loe-fort*, West Point	68 15	26 35	8 55 E
60. S. W. Point of same . . .	68 15	27 5	9 25 E
61. *Werro*, or *Weroy* Island . . .	67 30	25 5	7 25 E
62. Dronen, or Dronthem	63 40	27 50	10 10 E
63. *Ransilel*	63 15	24 5	6 25 E
64. *North* Point	62 20	23 1	5 21 E
65. Standland	62 10	22 13	4 33 E
66. *Kat*'s Ness, or Scut's Ness, S. Point	61 45	21 11	3 31 E
67. Hearle Isl. S. End	60 40	21 13	3 33 E
68. North *Bergen*	60 10	23 15	5 35 E
69. Rommel Isl. N. Part	69 25	23 15	5 35 E
70. Jedder	58 5	23 45	6 5 E
71. *Naze* of *Norway*	57 45	22 59	7 19 E
72. Maesterland	57 53	29 20	11 40 E

The MARINER'S SEA-COAST TABLE.

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E.
XXIII. COAST of the SOUND and BALTIC.			
	° ′	° ′	° ′
1. MARSDEN, or MARDEL . .	58 19	26 32	8 52 E
2. Caperwick	59 20	27 45	10 5 E
3. Larwick	58 54	26 55	9 15 E
4. Ansloo, or *Christiana*	59 40	27 35	9 55 E
5. Gottenberg Gat	57 50	29 50	12 10 E
6. Cape *Kol*	56 30	29 48	12 8 E
7. *Elsinore*	56 22	31 17	13 37 E
8. *Elsenbergh*	56 10	30 5	12 25 E
9. Valsterborn	55 28	30 35	12 55 E
10. *Christianople*	56 10	33 35	15 55 E
11. Calmer	56 40	34 10	16 30 E
12. *Oeland* S. End	56 17	33 5	15 25 E
13. *Oeland* N. End	57 20	34 35	16 55 E
14. Landfort	58 40	35 55	18 15 E
15. *Stockholm**	59 20	37 5	19 25 E
16. Aboo	60 40	38 45	21 5 E
17. *Rasbergh*	60 28	40 10	22 30 E
18. Borgo	60 40	43 35	25 55 E
19. Pelting Sound	60 32	44 25	26 45 E
20. *Wyburgh*	60 52	46 51	29 11 E
21. *Petersburgh**	60 0	48 0	30 20 E
22. *Narva*	59 27	46 0	28 20 E
23. Revel	59 35	42 26	24 46 E
24. *Nargin* Isl.	59 35	42 5	24 25 E
25. *Sybranness* in Dagoo, or Dagerort	59 0	40 35	22 55 E

Places Names.	Lat. N.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E.
	° ′	° ′	° ′
26. Arensbergh, in *Osel* Island . .	58 20	41 7	23 27 E
27. *Parnaw*	58 30	43 22	25 42 E
28. Runen Island	57 55	41 35	23 55 E
29. *Riga*	57 4	42 50	25 10 E
30. Domeness	57 30	41 35	23 55 E
31. Der Winda	57 15	39 41	22 1 E
32. Der Memel	55 48	39 11	21 31 E
33. Coningsburgh	54 43	39 10	21 30 E
34. *Dantzic**	54 22	36 28	18 48 E
35. Heel	54 40	36 43	19 3 E
36. Wisby, in Gotland	57 30	36 5	18 25 E
37. *Gotland* N. End	58 0	37 50	20 10 E
38. *Gotland*, S. End	57 0	35 20	17 40 E
39. *Bornholm*	55 15	32 20	14 40 E
40. Carmin, or Hamin	54 10	32 35	14 55 E
41. Jasmond or Rugen	54 30	31 35	13 55 E
42. *Rostock*	54 37	36 15	18 35 E
43. Straelsund	54 25	31 51	13 11 E
44. Wismar	54 10	29 35	11 55 E
45. Lubeck	54 6	27 35	9 50 E
46. *Copenhagen**	55 41	30 25	12 45 E
47. *Moscow*, Russia	55 56	58 0	40 20 E
48. Elsenore	56 22	30 17	12 37 E
49. *Uraniburg**	55 54	30 33	12 53 E
50. Anout, or *Anholt* Isl. . . .	56 50	28 41	11 1 E
51. Leson, or Lesnow Isl. . . .	57 5	28 5	10 25 E
52. The *Scaw*	57 30	27 55	10 15 E

☞ *The Places in the foregoing* Sea-Coast Table *are given* contiguously, *under distinct Heads, and numbered for Reference, to shew the Situation and* Geography *of Places, in Respect of each other, as well as their Latitudes and Longitudes. Whereas an* alphabetical Table *of the same Places* (especially of the less remarkable) *had required above double Room to explain their Situation. An Instance of which may be seen, of the Room taken to explain the Situation of alphabetical Places, in* Robertson's Navigation; *which yet gives no Idea of their* Contiguity.

The *Differences* of Longitudes are given from *Greenwich* Observatory, for determining the *Place, Declination,* or *Right Ascension,* of the *celestial* Bodies observed under a *distant* Meridian: All *Ephemerides,* in Books of Navigation, being properly made for the *principal Place* of a Nation's Observatory.

Hence the Reason of each Nation beginning the Longitude, or giving the Difference of Longitude, from their *Metropolis,* or principal Place of Observation; for the *Purposes* for which it is *principally* wanted.

Therefore, the Longitudes from *Ferro-Island, serve* only to compare with what all other Nations have fixed, or shall fix, them at; by first discovering the Difference of Longitudes from each *Metropolis* or principal *Observatory* of each Nation, respectively; and then reducing that Difference of Longitude to the Longitude from *Ferro*; by which Means an Agreement or Difference in the Longitudes, among the different Discoverers or Navigators, will be immediately seen; and thence a *Certainty,* or *Improvement* therein, may the sooner be had.

And we are of Opinion that all Nations should publish their cœlestial Observations quarterly, or annually, as they are made, for the Use of the Navigator, as here mentioned, and the Good of Mankind in general. Instead of which, we find the cœlestial *Observators* of our own *British* Nation, by some unaccountable Disposition or Principle they are possessed of, more backward or averse, than those of any other Nation, of communicating their Observations *(though they are paid for it with the public Money)* for the Use of the *Mathematicians,* in perfecting the THEORY of MOTION, and making *Astronomical Improvements:* On Account of which Degeneracy, they may be deemed MERE OBSERVATORS! far different from that Great Mathematical *Genius,* and *Astronomer,* (Second to Sir ISAAC NEWTON) the late *famous* and *communicative* Dr. HALLEY!

An

An *alphabetical* TABLE of the LATITUDES of *promiscuous* and remarkable PLACES, with their LONGITUDES from the Island of *FERRO*, and Difference of Longitude from *Greenwich* OBSERVATORY. According to the Authority of the Sieur DESPLACES, in his *Ephemerides*, from 1715 to 1725.

Places Names.	Lat. N. or S.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E. or W.
	° ′	° ′	° ′
AGRA, in Mogul	26 43 N	94 24	76 30 E
Alexandria, Syria	36 32 N	54 0	36 10 E
Aleppo, Syria	36 0 N	55 0	37 10 E
Alexandria, Ægypt	31 11 N	47 54	30 4 E
Amsterdam	52 23 N	22 53	5 3 E
Antibes	43 34 N	24 48	6 58 E
Avignon	43 57 N	22 32	4 42 E
Barcelona	41 26 N	19 53	2 3 E
Batavia, Indies	6 15 S	124 0	106 10 E
Berlin	52 33 N	31 7	13 17 E
Boulogna, Italy	44 30 N	29 17	21 27 E
Bourdeaux	44 50 N	16 55	0 55 W
Bourges	47 5 N	20 4	2 13 E
Breslau, Silesia	51 3 N	34 47	16 57 E
Brest	48 23 N	13 6	9 4 E
Bruges	51 12 N	20 47	2 57 E
Cadiz	36 37 N	11 50	10 20 E
Cairo, Ægypt	30 2 N	49 35	31 45 E
Cambray	50 10 N	20 54	3 4 E
Calais	50 57 N	19 27	1 37 E
Cape Bonne Esperance	34 15 N	37 44	19 54 E
Cape de Verd	14 43 N	0 30	17 20 W
Carthagena	10 30 N	302 10	75 40 W
Cayanne, America	4 56 N	324 30	53 20 W
Chester, England	53 13 N	14 51	2 58 W
Constantinople	41 6 N	46 33	28 43 E
Copenhagen	55 41 N	30 25	12 35 E
Cracow, Poland	50 10 N	38 0	20 10 E
Dunkirk	51 22 N	36 11	18 21 E
Dublin	53 11 N	10 30	7 20 W
Edinburgh	56 10 N	15 0	3 50 W
Florence	43 47 N	28 59	11 9 E
Frankfort	50 4 N	26 10	8 20 E
Guadalupe, America	16 20 N	316 11	61 39 W
Geneva	46 12 N	24 0	6 10 E
Goa	15 31 N	91 25	73 35 E
Goree, Cape Verd	14 39 N	0 35	17 15 W
GREENWICH OBSERVATORY . .	51 29 N	17 50	0 0
Hamburgh	53 41 N	28 15	10 25 E
Jerusalem	31 50 N	53 30	35 40 E
Isle of *Ferro*	28 5 N	0 0	17 50 W
Ispahan, Persia	32 30 N	70 30	52 40 E
Lima, in Peru	12 20 S	296 45	81 5 W
Lipsic	51 19 N	30 0	12 10 E
Lisbon	38 45 N	9 15	8 35 W
LONDON	51 31 N	17 45	0 5 W
Macao, China	22 12 N	130 48	112 58 E
Malacca, Indies	2 12 N	[illegible]	101 55 E
Madrid	40 26 N	[illegible]	3 30 W
Malta	35 43 N	32 9	14 18 E

Places Names.	Lat. N. or S.	Long. fr. *Ferro.*	D. Long. fr. *Gr.* E. or W.
	° ′	° ′	° ′
Marseilles	43 19 N	23 7	5 17 E
Martinico	14 44 N	316 41	61 9 W
Messina	38 21 N	33 56	16 6 E
Mexico	20 0 N	274 0	103 50 W
Milan	45 20 N	26 35	8 45 E
Montpellier	43 37 N	21 32	3 42 E
Moscow	55 30 N	57 0	39 10 E
Munich, Bavaria	48 18 N	29 30	11 40 E
Nants	47 13 N	16 7	1 42 W
Nancy	48 42 N	23 57	6 7 E
Naples	41 5 N	32 20	14 30 E
Nice	43 41 N	25 4	7 14 E
Olinda, America	8 13 S	342 30	35 20 W
Ostend	51 10 N	20 31	2 41 E
Oxford, England	51 45 N	16 26	1 24 W
Padua	45 31 N	29 1	11 11 E
PARIS OBSERVATORY . . .	48 50 N	20 0	2 10 E
Parma, Italy	44 44 N	28 27	10 37 E
Pekin, China	39 54 N	134 16	116 26 E
Perpignan	42 41 N	20 33	2 43 E
Porto Bello	9 33 N	297 50	80 0 W
Pondicherry, East Indies . . .	11 55 N	97 30	79 40 E
Prague	50 4 N	32 22	14 32 E
Canton, China	23 8 N	130 43	112 53 E
Quebec	46 55 N	307 47	70 3 W
Rochelle	46 10 N	16 37	1 13 W
Rodes	44 20 N	20 14	2 24 E
Rome	41 54 N	30 20	12 30 E
Rotterdam	51 56 N	22 30	4 40 E
Rouen	40 41 N	40 48	22 58 E
Siam, Indies	14 18 N	118 30	100 40 E
Smyrna	38 28 N	45 0	27 10 E
Stockholme	59 36 N	36 15	18 25 E
Strasburg	48 35 N	25 25	7 35 E
Surat, Indies	21 10 N	90 0	72 10 E
Toulon	43 7 N	23 35	5 45 E
Tripoly	32 54 N	31 11	13 21 E
Turin	44 50 N	25 10	7 20 E
Valparaiso, South America . .	33 28 N	305 28	72 22 W
Vienna	48 14 N	34 32	16 42 E
Venice	45 35 N	30 10	12 20 E
Uraniburgh	55 54 N	30 32	12 42 E

☞ In the SEA-COAST TABLE, the *Difference* of Longitude from *Greenwich* to *Paris Observatory*, is taken according to Dr. *Halley*, 2° 20′ E. which taken from 20°, East Longitude of *Paris* from *Ferro* Isle, leaves 17° 40′ E. Longitude of *Greenwich* from *Ferro*.

But, in the foregoing alphabetical Table, the Difference of Longitude from Greenwich *to* Paris *Observatory* is taken 2° 10′ E. only, according to the *French* Authority of *De la Caille*, by which the Differences of *Longitudes* E. or W. of *Greenwich Observatory* are adjusted from the given Longitudes (according to the Sieur DESPLACES) from *Ferro*.

The *Difference* of Longitude from *London* to *Ferro* in the New *Sea-Calendars* corrected, and *Mariner's* Compass newly rectified, is 17° 45′ W. which is 17° 50′ W. from *Greenwich*, and as much East from *Ferro*, agreeing with the *French Authority*; which we have corrected from *Halley*'s Authority, being only 10′ Difference.

Hence, if you add 10′ to some of the Longitudes from *Ferro*, in the *Sea-Coast Table*, they will nearly agree with some of these alphabetical Longitudes from *Ferro*.

☞ There is still another very large *Variation-Table* of Latitudes and Longitudes in *Robertson's Navigation*, as if the *terrestrial* Latitudes and Longitudes were never to be fixed, but shifted their Places with the Latitudes and Longitudes of the Stars. In our *Sea-Coast Table* the Latitudes and Longitudes of Places are according to the present *best Authorities*.

Captain BROWN's DIRECTIONS *for the* Safety *of Homeward-bound* SHIPS, *coming into the* ENGLISH CHANNEL.

FIRST, I recommend that all Ships and Veſſels, coming off the *Ocean*, be ſteered in a *Parallel* of Latitude, not more nor leſs than 49° 30′; keeping your *Lead* going, endeavour to ſtrike the Ground in 100 or 120 *Fathom* Water, which I call the outer *Edge* of the *Britiſh Bank*, or *Soundings*. Steer from thence E. *b*. S. ½ S. in Order to keep your *Latitudes* by the Compaſs, till by your *Log* you have run 80 Leagues from the above *Sounding* of 100 or 120 *Fathom* Eaſtward. Then may you *hawl* to the *Northward* and make Land at Pleaſure. But, if interrupted by Clouds, or hazy Weather, ſo that you have miſſed an Obſervation for ſeveral Days, whereby you cannot, with Certainty, determine your *Latitude*, in *ſuch Caſes*, if you come into *Soundings* from the *Weſtern Ocean*, obſerve, as before, to get Ground, if poſſible, in 100 or 120 *Fathoms*, which obtained, keep your *Log* and *Lead* going every Hour; ſteering E. *b*. S. ½ S. till, by your Diſtance, you have run from the aforeſaid *Soundings* 40 or 45 *Leagues*, and ſhoaled your Water; gradually leſſening to 60 *Fathoms*. Then you may find it difficult to determine whether you are to the *Northward*, or the *Southward* of *Scilly*; for the *Soundings* on both Sides I have often found to be pretty near alike. *Therefore*, to reſolve this Doubt, I recommend ſteering a *Southerly Courſe* from the aforeſaid *Diſtance* run, and Depth of 60 *Fathom*; and as you ſail to the *Southward* you will deepen your Water from 60 to 70 and 75 *Fathom*; which having done, you may depend on the *Britiſh Channel* being open, and clear from the Danger of either running aſhore on *Scilly*, or into St. *George's Channel*, too often the *Fate* and Caſe of Ships, who, for Want of ſuch Helps, are ſometimes loſt, with the Lives on Board, or dangerouſly bewildered.

When you have got the Depth of 70 or 75 *Fathom*, aforeſaid, immediately alter the *Southerly Courſe* to E. or E. *b*. S. till, by your Diſtance, you are ſhot within *Scilly-Iſlands*; the ſaid Places lying about 62 or 3 *Leagues* from the *Weſtern* Edge of the *Britiſh* Soundings, then may you hawl to the *Northward*, and make the *Land*, as you think proper.

But, if you come from the *Southward*, the Coaſt of *Spain* and *Portugal*, or Bay of *Biſcay*, you muſt be likewiſe careful how you come in with the Channel, in thick Weather; for as you ſtrike Ground with your *Lead*, you will often find *coarſe Soundings*; and, if near *Uſhant*, Gravel, with ſmall Stones; which Ground is much ſteeper than the Edge of the *Weſtern Bank*. For, if you come into your *Soundings* with the Channel *open*, ſteering to the *Northward*, to make the *Land's End*, *Lizard*, *&c.* in running eight or ten *Leagues*, you will go from 100, to 75, or 70 *Fathom*, in the ſaid *Diſtance*. Whereas being to the *Weſtward*, you may run 20 or 30 *Leagues*, and not make more *Difference* in your *Sounding* than aforeſaid. So that, from what I have advanced, it will be eaſy to determine whether you have the Channel open or not, a *Diſpute* that has often puzzled the moſt *experienced Mariners*, and ſkilful Navigators, uſing theſe Seas.

However, I muſt obſerve, that ſome Times, in the aforeſaid *Soundings*, I have met with a ſtrong *Northerly Current*, at the Rate of about one Mile an Hour, which, and about 17 Degrees *Variation Weſt*, at this Time, ſhould be duly accounted for, in Order to keep the true *Parallel* of *Latitude*, afore-mentioned. As, likewiſe, in ſome *Sea-Charts*, the Latitude of the *Land's-End*, *Lizard*, *&c.* are laid down, *ten Miles* to the *Northward* of their true Latitude. So that if theſe *Impediments* are not all duly conſidered, and allowed for, I ſay, from what I have already obſerved, an *Error* may be eaſily contracted, greatly endangering the Loſs of a *Ship*.

Theſe *Directions* being carefully obſerved, your Latitude and Diſtance will be corrected, and a tolerable Knowledge of the Ship's Poſition may be inferred. And I would alſo adviſe all Ships to be careful how they deal with the *French Coaſt*. For let the Weather be as it will, after having run the *Diſtance* aforeſaid, off the *Iſlands* of *Scilly*, then make bold with your *own Coaſt*, in Order to ſhun falling in with the Iſlands of *Guernſey*, *Jerſey*, *&c.* which ſo often ends in frightful Circumſtances of both Ships and Lives.

AND, *laſtly*, obſerve that in ſounding a *Stream*, and to the *Weſtward* of *Scilly*, you will find *bluiſh*, *oozy Ground*; ſo that when, by your *Lead*, you have ſuch Ground, you may be aſſured where you are, and therefore ſhape your Courſe accordingly.

Note, *That in coming up the Channel when you are a-breaſt of the* Lizard, *you will have* 50 *Fathom Water, and of the* Start Point 45 *Fathom*.

The practical Mariner finding it difficult to get Ground in a Storm, or hard blowing Weather at 100 *or* 120 *Fathom, coming into Channel, he may follow the above Rules; getting Ground at* 80 *Fathom or leſs, by making proper Allowance, according to the Depth of Water.*

COMMENCEMENT

COMMENCEMENT of the most FAMOUS ÆRAS in YEARS *current* and *complete*, before and since CHRIST, Julian Style.
☞ *The Want of Distinction before, between* current *and* complete *Years, has occasioned great Confusion in* CHRONOLOGY.

Remarkable ÆRAS.	Week-Day.	Month Day. O. S.	CURRENT. Years before Christ.	Dif. com.	Yrs. Jul. Per.	Dif. com.	COMPLETE. Years before Christ.	Dif. com.	Years Julian Period.	Dif. com.	Days. +	Olympiads. Ys. Ols	Olympic Years.	Dif. com.	Cycles. ☉	☽	Indict.
Commencement of the Jul. *Period*	*Monday*	*Jan.* 1	4713		1		4712		1 bef. or fin. Per		364	Current	Current		1	1	1
				763		763		763		763							
The common *Æra* of Creation. *Strauchius*. Neglecting other traditional *Æras* of 5508, 5199, and 3955 before *Christ*	unknn.	unknn.	3950		764		3949		763		unknn.	. . .	. . .		8	[illegible]	[illegible]
				1656		1656		1656		1656							
The *Æra* of the Deluge	unknn.	unknn.	2294		2420		2293		2419		unknn.	. . .	. . .		17		5
		☽ after		1518		1518		1518		1518	Ds. fr.						
—— The *Greek Olympiads* . . .	*Monday*	Solst. *July* 8	776		3938		775		3937		Solst. to Ys End	1 1	1		16	5	8
				23		23		23		23				23			
—— The Foundation of *Rome*	*Monday*	*Apr.* 21	753		3961		752		3960		254	4 6	24		13	[illegible]	1
				6		6		6		6				6			
—— *Nabonassar*, King of *Babylon*	*Wednes.*	*Feb.* 26	747		3967		746		3966		308	2 8	30		11	15	7
				423		423		423		423				423			
——The Death of *Alexander* the *Gr.*	*Sunday*	*No.* 12	324		4390		323		4389		49	1 114	45[illegible]		[illegible]	1	10
				12		12		12		12				12			
—— The *Syrians* and *Chaldeans*	*Monday*	*Oct.* 1	312		4402		311		4401		91	1 117	4[illegible]5		[illegible]	13	7
				267		267		267		267				267			
—— *Jul. Cæsar*, Corrn. of Calend.	*Friday*	*Jan.* 1	45		4669		44		4668		364	4 183	732		2	14	4
				7		7		7		7				7			
—— *Spain*; or *Spanish* Æra	*Sunday*	*Jan.* 1	38		4676		37		4675		364	3 184	739		28	21	11
			fin. Chr	37		38		38		38				38			
—— CHRIST, or *Christian Æra*	*Satur.*	*Jan.* 1	1		4714		1 bef. or fin. Chr		4713		364	1 195	777		[illegible]	[illegible]	4
				283		283		283		283				283			
—— The *Æthiopians* and *Abyssines*, called also *Dioclesian*, or *Æra* of *Martyrs* . . .	*Friday*	*Aug.* 29	284		4997		283		4996		254	4 265	1060		13	19	2
				338		338		338		338				338			
—— *Hegira*, or *Turkish* and *Arabic Æra*	*Friday*	*July* 16	622		5335		621		5334		168	2 350	1393		[illegible]	[illegible]	10
				10		10		10		10				10			
—— *Jesdegird*, or *Persian Æra*	*Tuesday*	*Jun.* 16	632		5345		631		5344		198	4 352	1403		[illegible]	[illegible]	5
				447		447		447		447				447			
—— 2d *Persian*, or *Jalalean Æra*	*Thurs.*	*Mar.* 14	1079		5792		1078		5791		292	3 464	1855		[illegible]	16	2
				503		503		503		503				503			
—— Pope *Gregory*'s reforming the *Calender*	*Friday*	*Oct.* 5	1582		6295		1581		6294		87	2 590	2358		[illegible]	6	10

☞ Chronological Dates of all Kinds are *most truly* ascertained by a Concurrence or *Correspondence* discovered, in the Week-Days, from the Years of different *Æras*, to the *same Event*.

N. B. The *above Table* correctly distinguishes between the *current* and *complete Julian* Years, before and since Christ, *(confusedly given by Chronologers)* and therefore the *Æras* here given are fitted for the *Reduction of Chronology*, or for reducing one Account of Time to another. Which is effected by Means of Tables, further on, estimating the Number of *Years* and *Month-Days* of any particular Kind, equivalent to a given Number of *Julian Years* and *Month-Days*, and the *contrary*. And these Tables are likewise fitted for determining the Number of the *Feriæ*, or Week-Day, correspondent to a given *Month-Day* of different Kinds of Years. *See p.* 141, for the Form, Length, Beginning, and Ending, of the *Jewish, Egyptian, Arabic, Turkish*, and also antient *Grecian Year*. Any Number of which, and their Month-Days, are reducible to an equivalent Number of *Julian* Years and Month-Days; by the RULES and EXAMPLES hereafter exhibited.

The *Egyptian* or *Persian* Year consists of 365 Days without any *Variation*; and each Month of 30 Days, with 5 Days *added* at the End of the *last Month*. This Year is compleated 6 Hours sooner than the *mean Julian* Year, and gains 1 Day of the *Julian* Account in 4 Years. And in the *Space* of 1460 *Egyptian* or *Persian* Years, the same Day of the Year and Month returns. For 1460 Years *Julian* make 1461 Years *Egyptian*; when the 1st Day of the *Egyptian* Month *Thoth* happens on the 1st of *January Julian* Style, 4 Years after which the 1st of *Thoth* happens on the 31st of *December*, and in 4 more on the 30th Day, *&c.* retreating 1 Day in every 4 Years *Julian* Style. Therefore, 1 Day retreated or retrograded every 4 Years *Julian* is 365 Days retreated in 1460 *Julian* Years, when the 1st of *Thoth* returns to *January* 1, *Julian* Style. This *Egyptian* or *Persian* Year, though fit for astronomical Computations, is improper for the Purposes of civil Life. The antient *Persians*, by a Correction of their *Calender*, at certain Periods, made their Year to consist of 365d 5h 49m 53s 20th, according to the *French Authors*.

The *Arabians* and *Turks* make their Years consist of 12 synodical Lunations, and in 30 Years, which is their Period, they reckon 19 Years of 354 Days, and 11 Years of 355 Days, *viz.* 2d, 5, 8, 10, 13, 16, 19, 20, 24, 27, and 30th, of 355 Days each; the Rest, 1st, 3, 4th, *&c.* of 354 Days; which Period of Years contain 10631 Days *exactly*. They make the Product of 30 Years, Periods, or Cycles in Succession, that is of 29d 12h 44m to a Lunation. The Commencement of their Year is unfixed, and wanders through all the Seasons successively.

	d	h	m			d	h		
Their *Lunar* Year is	354	8	48		*Julian* Year	365	6	at a Mean	
Solar Year about	365	5	49		Therefore . . .	537 *Turkish*			Or 235 *Turkish* Years
Dif.	10	21	1		Make	521 *Julian* Years.			Make 228 *Julian* Years.

The *Jewish* and *Grecian* Years follow their particular Forms as described in *Page* 141.

The Year, represented by a *Ring*, or *Snake* with the Tail turned into its Mouth, has different Beginnings, and Successions of the same Period in different Nations. Some begin their Year at the *Solstices*, others at the *Equinoxes*. And, in *France*, before the Year 1564, we find, by a *French Ephemeris*, that their Year commenced at *Easter*. But *Charles* IX. we find, in the same *Ephemeris*, ordered the Commencement to be on the 1st of *January*, which was confirmed and established by Order of the *French* Council and Parliament to begin the 1st of *January*, 1567.

☞ *The Astronomers begin their Year on* Jan. 0, *or* 31*st of* December, *at Noon.*

REDUCTION of CHRONOLOGY.

A TABLE for *reducing Julian* Years into Days, and the contrary.

Jul. Yrs.	Days correspondent.	*Jul.* Yrs.	Days correspondent.
*1	365	600	219150
*2	730	700	255675
*3	1095	800	292200
4	1461	900	328725
8	2922	1000	365250
12	4383	2000	730500
16	5844	3000	1095750
20	7305	4000	1461000
24	8766	5000	1826250
28	10227	6000	2191500
32	11688		
36	13149		
40	14610		
44	16071		
48	17532		
52	18993		
56	20454		
60	21915		
64	23376		
68	24837		
72	26298		
76	27759		
80	29220		
84	30681		
88	32142		
92	33603		
96	35064		
100	36525		
200	73050		
300	109575		
400	146100		
500	182625		

N. B. There being 1461 Days in every 4 *Julian* Years, when either 1st, 2d, or 3d Year (marked with *) is *Bissextile*, 1 Day must be *added* to the Number of Days in the *right* Hand Column, for the *true* N°. of Days in Succession from the 1st Year, as appears from the 3 first Years of 365 Days each. *See P.* 129.

A TABLE for *reducing Turkish* or *Arabic* Years into Days, and the contrary.

Turkish Yrs.	Days correspondent.	*Turkish* Yrs.	Days correspondent.
1	354	21	7442
. 2	709	22	7796
3	1063	23	8150
4	1417	. 24	8505
. 5	1772	25	8859
6	2126	26	9213
7	2480	. 27	9568
. 8	2835	28	9922
9	3189	29	10276
. 10	3544	. 30	10631
11	3898	60	21262
12	4252	90	31893
. 13	4607	120	42524
14	4961	150	53155
15	5315	180	63786
. 16	5670	210	74417
17	6024	240	85048
18	6378	270	95679
. 19	6733	300	106310
. 20	7088	600	212620

21 *Years* 2, 5, 7 ~~8~~, 10, 13, 16, 18 ~~19~~, ~~20~~, 24, 26 ~~27~~, 29 ~~30~~, *contain* 355 Days *each.*

Years 1, 3, 4, 6, 19 8 ~~7~~, 9, 11, 12, 14, 15, 17, ~~18~~, ~~21~~ 20 22, 23, 25, ~~26~~, 28, ~~29~~, *contain* 354 Days *each:* Making 30 Years of 10631 Days. 27 30

N. B. 235 *Turkish* Years make 228 *Julian* Years, or 537 *Turkish* make 521 *Julian* Years.

TABLE for reducing *Persian* or *Egyptian* YEARS into DAYS, and the contrary.

Yrs.	Days.	Yrs.	Days.
1	365	30	14950
2	730	40	14600
3	1095	50	18250
4	1460	60	21900
5	1825	70	25550
6	2190	80	29200
7	2555	90	32850
8	2920	100	36500
9	3285	200	73000
10	3650	300	109500
11	4015	400	146000
12	4380	500	182500
13	4745	600	219000
14	5110	700	255500
15	5475	800	292000
16	5840	900	328500
17	6205	1000	365000
18	6570		
19	6935		
20	7300		

Doctor *Newton*, in his *Cosmographia*, gives an Account of 245 Days to the End of the 8th *Persian* Month *Aban*, instead of 240, which Month he calls *Apenina Wabak*, and differs 5 Days in the following Months as he does in the Names of some other of his Months, as also does Mr. *Ferguson*, from some of our *Persian* and *Turkish* Names of Months from good Authority, which makes the 12th *Persian*, not 8th Month, intercalary of 5 Days; like the 12th *Ægyptian* Month.

TABLE of the Number of DAYS to the END of each *Persian* MONTH.

N°.	*Persian* Months.	Days.
1	*Pharavardin*	30
2	*Adarpahascht*	60
3	*Chardad*	90
4	*Thir*	120
5	*Mardad*	150
6	*Scheheriz*	180
7	*Mehar*	210
8	*Aban*	240
9	*Adar*	270
10	*Di*	300
11	*Behemen*	330
12	*Asphardar*, or *Aspirer* . . .	365

TABLE of the Number of DAYS to the END of each *Egyptian* MONTH.

Beginning.	N°.	*Ægyptian Months.*	Days
29 Aug.	1	*Thoth*	30
28 Sept.	2	*Paophi*	60
28 Oct.	3	*Athir*	90
27 Nov.	4	*Chojac*	120
27 Dec.	5	*Tibi*	150
26 Jan.	6	*Mechir*	18[illegible]
25 Feb.	7	*Phamenoth*	21[illegible]
27 March	8	*Parmuthi*	2[illegible]
26 April	9	*Pacon*	2[illegible]
26 May	10	*Payni*	300
25 June	11	*Epiphi*	33[illegible]
25 July	12	*Mesori*, or *Epagomenæ*, 5 Days added.	365

TABLE of the Number of DAYS to the END of the *Julian* MONTHS.

N°.	*Months.*	*Years* com.	*Years* Bissex.
1	January	Ds 31	Ds 31
2	February	59	60
3	March	90	91
4	April	120	121
5	May	151	152
6	June	181	182
7	July	212	213
8	August	243	244
9	September	273	274
10	October	304	305
11	November	334	335
12	December	365	366

N. B. 365d ~~5h 49m~~ 6 *Julian* Yr.

TABLE of the Number of DAYS to the END of the *Turkish* or *Arabic* MONTHS.

Beginning.	N°.	*Turkish Months.*	Days
16 July	1	*Muh'Arram*	30
15 Aug.	2	*Saphar*	59
13 Sept.	3	*Rabie* I.	89
13 Octo.	4	*Rabie* II.	118
11 Nov.	5	*Giumadi* I.	148
11 Dec.	6	*Giumadi* II.	177
9 Jan.	7	*Regeb*	207
8 Feb.	8	*Sabeben*	236
9 March	9	*Ramadhan*	266
8 April	10	*Scheual*	295
7 May	11	*Dulkadate*	325
7 June	12	*Dulhakate*	354
		In Year intercalary	355

365d 8h 48 Turk. Yr.

A TABLE for *finding* the WEEK-DAYS. *According to the* Turkish *Account of Time.*

Sunday. I.	*Monday.* II.	*Tuesday.* III.	*Wedn.* IV.	*Thurs.* V.	*Friday.* VI.	*Saturday* VII.
	180	Turkish	150	Cycles	120	
90		60		30		0
Turkish	2	Years	and	1	Months.	*Muharram*
5	*Saphar*	*Rabie* I.	4	*Rabie* II.		3
		7	-		6	
	10			9	*Giumadi* I.	8
13			12		11	
Giumadi II.	*Regeb*	15			14	
	18		*Sabben*	17		16
21			20	*Ramaden*	19	*Schaual*
Dulkadati		23			22	
	26			25		24
29		*Dulhakati*	28		27	
				30		

Arabic or Turkish CYCLES, the *Products* of 210 Years.

210	420	630	840	1050	1260	1470
1680	1890	2100	2310	2520	2730	2940

365.5.49 is a Gregorian year

REDUCTION of CHRONOLOGY.

Construction. The Numbers at the Top of the *Table* are the *Products* of 30 Years in a *retrograde* Order. All the other Numbers in the *Table* are the Cycles current from 1 to 30 Years. The *Months* are placed in the *Intervals*, (shewing the *Feria* or Week-Day to the Beginning of each Month, for given Years, in the same Column) to find the *Feria*, or Week-day, as follows.

☞ *The* 210 *Cycle of Years serve for* 30 *Weeks, and answers to the Cycle of the* Sun 28.

EXAMPLE I. *To find the* Feria, *or Week-Day, at the Death of the Emperor* AMURAT II. *in the* 855*th Year of the* Turkish Hegira, *on the* 1*st Day of the Month* Muharram, *current?*

The Years of the Cycle nearest to 855 are 840.
— 840

Rem. 15 Years.

Seek, from the *Table*, the *Feria* to these 15 Years, being 3, and the *Feria* to the Month *Muharram* being 7, add these together, making 10, to which add the 1st Day of *Muharram*, and the *Sum* will be 11, which divided by 7, there will remain 4, or the 4th *Feria* being *Wednesday*, required.

OTHERWISE, *To find the* Julian *Date*, O. S. *corresponding to the* said Turkish *Date?*

Turkish Years completed	Days
600	212620
240	85048
14	4961

Years 854 completed.
Muharram 1 Day current . . . 0, or 1 Day less completed [than current.
Sum . . 302629 Days *completed*.
Julian Years 800 completed 292200

10429
28 . . . 10227

Add, 828 Yrs. Jul. and 202 Days, both *completed*.
To *July* 16th, 622 Years *current*, when the *Hegira* commenced.
Sum, *Jul.* 16th, 1450 current, and 202 Days more *completed*;
Or, *February* 3, 1451, current, O. S. (*by Table*, P. 32) When the Emperor *Amurat* died.
NOW, the *Dominical* Letter (by *Tab. p.* 148.) for 1451, O. S. is C, and *February* 3, (by *Table*, P. 149) is evidently on a *Wednesday*, required.

EXAMPLE II. *To find the* Turkish *Date corresponding to the* Julian *Date of the* 29*th of* May, 1452, O. S. (*being on a* Monday) *when* Mahomet II. *began his Reign?*

Yrs cur. Chr. D.	Yrs cur. Ds cur.	Yrs Days
1452, May 29 =	1451 . 515 =	1452 + 150, Bissextile.
622, July 16 =	622 . 197	when *Hegira* begun.

Julian Years Diff. 829 . 318 completed.

† *To find the Week-Day?*
856 Year current
— 840 Cycle

Rem. 16

Feria 7
Giumadi I. 6
Day 10

7)33(3

Monday . . 2 Rem.
Feria.

† *The above follows and refers to what is done at the End of the Operation in the next Column. See* †.

	Days.
Julian Years 800	292200
28	10227
1	365
	+ 318
829	*Sum*, 303110
Turkish Years 600	212620
	90490
240	85048
	5442
15	5315
Sum, 855 Years, and	127 Days completed.
Rabie II.	118
Giumadi I.	9 completed.

Or, 856 Year of the *Hegira*, on the 10th Day of *Giumadi* I. current. †

Le Sieur *Desplaces*, by Mistake, (in the *Preface* to his *Ephemerides*, from 1715 to 1725, Page 30) brings out 856 of *Hegira*, completed on the 1st of *Saphar* current, who says the *Turks* reckon it 857 of *Hegira*, on the 1st of the Month *Saphar*, current, when *Mahomet* II. began his Reign, which cannot agree with the 29th of *May*, 1452, current, on a *Monday*: The 1st of *Saphar*, in the 857 of *Hegira*, current, being on a *Sunday*, as our Table foregoing shews, according to the *Rule* given. And the 1st of *Saphar*, in the 856 of *Hegira* current, by the *same Rule*, is on a *Tuesday*.

☞ *The same Method serves for reducing the* Julian *into* Persian *or* Egyptian Date, *and the contrary.*

Whence also the *Persian* may be reduced to the *Turkish* Account, and the contrary.

☞ *Though subtracting* Julian *Years and Days current from other* Julian *Years and Days current, leaves the Difference in Years and Days* complete, *the same as if those* Julian *Years and Days current were first reduced to Years and Days complete, and their Difference then taken, both the Numbers of Years current being* Bissextile, *or* both common; *yet, as these Numbers may be of different Kinds, if the current Years and Days be always reduced to those which are complete, and then the* Difference *or* Sum *thereof be taken, for Reduction of one* Date *to another, as* different Occasions *shall require, the Hazard of mistaking a Day, in computing by Years current, will, by this Means, be avoided.*

REDUCTION of CHRONOLOGY.

EXAMPLE III. *To find the* YEAR *of the* TURKISH HEGIRA *corresponding with the* 20*th of* May 1761, N. S. *on a* Wednesday; *being* May 9, 1761, O. S. *current, or* May 8, 1760 *Years complete?*

Jul. Years complete	Days
1000	365250
700	255675
60	21915
1760, *Apr.* complete . .	120
In *May*, Days complete . .	8
From *Chr.* to the present Julian Date . .	642968
From *Chr.* to the *Hegira*, . . Deduct . .	227016
Since the *Hegira* . .	415952 Days, complete.
Turkish Years 900 . . Deduct	318930
	97022
270 . . Deduct	95679
	1343
3 . . Deduct	1063
1173 Y^s complete, &	280 Days, complete.
Ramadhan, complete . .	266
Scheual . .	14 Days, complete.

The *Turkish Hegira* begun *July* the 16th, 622 current.

Jul. Yrs. comp.	Days
600	219150
20	7305
1	365
Comp. Years 621, *June*, complete . .	181
In *July*, Days complete . .	15
To the *Hegira* . . .	227016 Ds.
In 1*st Example* . . .	302629 Ds. since the *Hegira*.

HENCE *to prove the Answer to the First* EXAM.

Jul. Y^rs. comp.	529645 Sum.
1000 . . .	365250 —
	164395
400 . . .	146100 —
	18295
48	17532 —
	763
2	730

1450 Y^rs complete, and 33 Days, complete. *Viz.* 1451, *February* 3, *current*, as *before*, the Date of the *Christian Æra*, corresponding with the Date of the *Hegira*, 855, on the 1st Day of the Month *Muharram*.

EXAMPLE IV. *To reduce the* Julian *Years and Months current, suppose the* 11*th of* September, 1781, O. S. *since* Christ, *into the Years and Months* current *of the* Persian Jesdegird *and the* contrary?

Jul. Y^rs. comp.	Days
1000	365250
700	255675
80	29220
1780 Y^rs. *Aug.* complete	243
In *September*, Days complete . .	10
Since the *Christian Æra* . .	650398
To the *Jesdegird* . .	230639
Since the *Jesdegird* . .	419759
Persian Years 1000 . . . . . Deduct	365000
	54759
100 . . . . Deduct	36500
	18259
50 . . . . Deduct	18250

1150 Years complete, and . . . 9 Days complete of *Pharawardin*.

Viz. in 1151 Year of *Jesdegird*, on the 10th of *Pharawardin*, current.

☞ *The Date of the* Jesdegird *may be reduced to the* Julian Account, *and thence to the* Hegira, *or any other Account of Time you please, by the foregoing* Rules.

☞ *The* Persian Jesdegird *began* June *the* 16*th*, 632 *of* Christ *current, on a* Tuesday.

Jul. Yrs. comp.	Days
600	219150
28	10227
3	1095
631 Y^s comp. *May* comp.	152 Bissextile.
In *June*, compl. . .	15
To the *Jesdegird*, . .	230639

CONTRARILY, *To find the* Christian Æra, *correspondent to the* 1151 *Year of* Jesdegird, *on the* 10*th of* Pharawardin, *current?*

Persian Years	Days
1000	365000
100	36500
50	18250
1150 Years complete.	
In *Pharawardin*	9
Æra of *Jesdegird* . .	419759
To that *Æra* from *Christ* . .	230639
Sum . .	650398
Years Julian 1000 . . . Deduct	365250
	2851[illegible]
700 . . . Deduct	[illegible]
	473
80 . . .	[illegible]
1780 Years co[illegible]	
Aug. [illegible]	
I[illegible]	
Or *Sept* [illegible]	

REDUCTION *of* CHRONOLOGY.

EXAMPLE V. *To find the* WEEK-DAY *according to* ANY ACCOUNT *of* TIME?

RULE. Divide the Number of the Days complete in the Account by 7, and add thereto the Number of the *Feria* on which the Account or *Æra* began, then dividing the Sum by 7, the Remainder will be the Number of the *Feria* corresponding to the *Week-Day*, required.

N. B. *The complete Days are always 1 less than the Days current.*

THUS, in *Example* I. The Number of Days in the 855th Year of *Hegira*, on the 1ſt of *Mubarram*, is 302629, which divided by 7, leaves 5, to which 6 being added, the Number of *Feria* (anſwering to *Friday*) when the *Æra* began, the Sum is 11, which divided by 7, the Remainder 4 is the *Feria* anſwering to *Wednesday*, required, as before found by *other Methods*.

Again, in *Example* II. To the 856th Year of *Hegira*, on the 10th Day of *Gumadi* I. current, are 303110 Days *complete*, which divided by 7 there remains 3, to which if 6 be added, the Number of *Feria* (anſwering to *Friday*) when the *Æra* began, the *Sum* is 9, which divided by 7, the *Remainder* 2, is the *Feria* anſwering to *Monday*, as before found by *other Methods*.

Again, in *Example* III. To the 20th of *May*, 1761, N. S. are 642968 Days *complete*, which divided by 7 there remains 4, to which adding 7, the Number of the *Feria* when the *Chriſtian Æra* began (anſwering to *Saturday*) the Sum is 11, which divided by 7, the Remainder 4, is the Number of the *Feria* anſwering to *Wedneſday*, as before found by other *Methods*.

Again, in *Example* III. To 1774 Years of the *Hegira*, on the 15th Day of *Shenal* current, are 415952 Days *complete*, which divided by 7, there remain 5, to which adding 6, the Number of *Feria* when the *Hegira* began (anſwering to *Friday*) the Sum is 11, which divided by 7, the Remainder 4 is the Number of *Feria*, anſwering to *Wedneſday*, as before found, correſpondent to the Date of the *Chriſtian Æra*, *May* 20, 1761, N. S.

Again, in *Example* IV. To 1151ſt Year of *Jeſdegird*, on the 10th of *Pharawardin* current, are 419759 Days *complete*, which divided by 7, there remains 4, to which adding 3, the Number of the *Feria* when the *Jeſdegird-Æra* began, (*viz. Tueſday*) the Sum will be 7, the Number of the *Feria*, or *Saturday*, on the Day of the *Jeſdegird*, required, correſponding to the 11th of *September*, 1781, *current*, O. S.

By the like *Methods*, the *Reduction* of all ÆRAS of Chronology are performed, and the *Week-Day* to the Month-Day in each *Æra* found.

The OLD is reduced to the NEW STILE, and the *contrary*, by the Methods already ſhewn.

☞ *If the* Week-Day *comes out the ſame to the correſponding* Dates *of* Chronology, *by different Methods of computing the Week-Day, you may be ſure the Reduction of the Chronology is made right.*

CHRONOLOGICAL SCALE of an ÆRA beginning BEFORE CHRIST.

Succeſſive Years complete of the ÆRA before Chr.									Chr|iſt.	Succeſſive Years complete of the ÆRA ſince Chr.							
Beg. Æra	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Years current before Chriſt Julian Style.									Chr|iſt.	Years current ſince Chriſt Julian Style.							

☞ The *Spaces* of the under Column in which the *Numbers* are placed are for the Years *current*, from their Beginning, on the Left: The Ends of thoſe *Spaces*, to the Right, are for the Years complete, before and ſince Chriſt.

CHRONOLOGICAL SCALE of an ÆRA beginning SINCE CHRIST.

Retrogreſſive Years complete of the ÆRA before Chr.									Chr|iſt.	Succeſſive Years complete of the ÆRA ſince Chr.							
10	9	8	7	6	5	4	3	2	1	Beg. Æra	1	2	3	4	5	6	7
9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	9
Years current before Chriſt Julian Style.									Chr|iſt.	Years current ſince Chriſt Julian Style.							

☞ The *Spaces* of the under Column in which the *Numbers* are placed are for the Years *current*, from their Beginning, on the Left: The *Ends* of thoſe *Spaces*, to the Right, are for the Years *complete*, before and ſince *Chriſt*.

AXIOMS.

1. A Year current, is the Year running on, not yet completed.
2. Years *current* are always 1 more than Years *complete*, in all *Dates*, before and ſince Chriſt.
3. Days *current* are 1 more than Days *complete*, *&c.*
4. Years and Days *complete* added to, or ſubtracted from, Years and Days *complete*, the Remainder will be Years and Days *complete*.
5. Years and Days complete being added to, or ſubtracted from, Years and Days current, the *Sum*, or *Remainder*, will be Years and Days current.
6. Years and Days *current* being ſubtracted from Years and Days *current*, the Remainder will be Years and Days *complete*.

OF ÆRAS BEGINNING and DATES, *both* Before CHRIST.

PROPOSITION I. *To determine the Number of* Julian *Years current of an Æra, from the Beginning to the preſent Date thereof, before Chriſt, being given, and thence to give other chronological Rules?*

RULE. By the former of the two *chronological* Scales it is evident, that *If you deduct the whole* Julian *Years current before Chriſt, of the preſent Date, from the whole* Julian *Years current, of the Date when the Æra before Chriſt, began*, both in the lower Column, *the* Remainder

REDUCTION of CHRONOLOGY.

will be the Number of whole *Years* complete, in the upper Column, (and also Years and Days complete, which Years and Days are in both Dates) *since the* Commencement *of that* Æra.

Which *whole Years* Difference are *complete Years*, at each *annual* Return of the same *Month-Day*, on which the said Æra began. To which Difference of *Dates* current, or Number of complete Years, since the Æra, if 1 Year be added, it will give the Number of Years current of that Æra; because (as was before observed) the Number of Years *current* are always 1 more than the Number of Years complete.

Otherwise, If you subtract 1 *Year* from the *present* Year's *Date* current, before Christ, (to make that Date *complete* Years) and then *deduct* them from the Years of the *current Date* at the Æra's Beginning, before *Christ*, the Remainder will also be the *Year of that Æra*, since it began.

PUT Æ for the *Years current* at the Æra's Beginning before *Christ*.
P, for the *present* Year, current before *Christ*.
Y, for the Number of Years current of that Æra:

HENCE, we have these EQUATIONS.
1. $Æ - P + 1 = Y$
2. $Æ - Y + 1 = P$
3. $P + Y - 1 = Æ$
Julian *Years current*.

EXAMPLE 1. *To find the Number of the* Julian *Year* current, Y, *or Year of the* Julian *Period, beginning in the* 4713*th Year* current *before Christ, answering to the* 324*th Year, present Date*, P, *before Christ?*

By the 1st *Equation*.
$Æ = 4713$
$+ 1$
4714
$P = 324 -$

The Year of the *Julian* Period, $Y = 4390$ required. current.

EXAMPLE 2. *To find* P, *the present Date, current before Christ, from the Year*, Y, *of a given Æra, the* 93*d current of the* Building *of* Rome, *and the Beginning of that Æra*, Æ, 753 *Years current before* Christ?

By the 2d *Equation*.
$Æ = 753$
$+ 1$
754
$Y = 93 -$

Present *Date* before Christ, $P = 661$ required. current.

EXAMPLE 3. *To find the* Date, Æ, *before* Christ, *of the Beginning of an Æra, from* Y, *the Years of that Æra*, 280 current *since it began, and* P, *the present* Date, *in the* 45*th Year current before* Christ, *being given?*

By the 3d *Equation*.
$P = 45$
$Y = 280$
345
$- 1$

The *Æra*, the Death of *Alexander the Great* 324 bef. Chr. *current*, reqd.

Of ÆRAS begining BEFORE, and DATES SINCE CHRIST.

PROPOSITION II. *To determine the Years*, Y, *of an Æra*, Æ, *begining at a given* Date, Julian *Style, before Christ, answerable to a present Year's* Date, P, Julian *Style, since Christ; and thence to give other* chronological *Rules?*

RULE. By the former of the two chronological *Scales*, it is evident, that *If* 1 *less than the Years current since Christ* (being the Years complete) *be added to the Years* current *of the Commencement of an Æra, before Christ, the Sum thereof will be the Years* complete *of that Æra, since it began, at Return of the same Month-Day.*

And therefore 1 being added to those *complete* Years (by *Axiom* 2) will be the Years *current* of that Æra.

Otherwise, the Number of the present Julian Year current, *since Christ*, being added to the Number of Years current, *before Christ*, at the *Commencement* of the Æra, the *Sum* thereof will be the Number of the Year *current* of that Æra, since it began.

HENCE, we have these EQUATIONS.
1. $Æ + P = Y.$
2. $Y - Æ = P.$
3. $Y - P = Æ.$
Julian *Years current*.

EXAMPLE 1. *To find* Y, *the Number of the* Julian *Year of the* Greek *Olympiads, whose* Æra, Æ, *began in the* 776*th* Julian *Year current before Christ, answering to the present Year*, P, 1760, *since Christ, current?*

By the 1st *Equation*.
$Æ = 776$
$P = 1760$

Julian Year of the *Greek Olympiads* . . $Y = 2536$ current, req.

EXAMPLE 2. *To find* P, *the present Date, current since Christ, from the Number of the Year* Y, *of a given* Æra, 2507 *Years current, of* Nabonassar, *the Beginning of which* Æra, Æ, *being* 747 *Years before Christ?*

By the 2d *Equation*.
$Y = 2507$
$Æ = 747$

Present *Date* since Christ, $P = 1760$ required. current.

EXAMPLE 3. *To find the* Date, Æ, *before Christ, of the Beginning of an* Æra, *from* Y, *the Years of that* Æra, 1815, *current since it began; and* P, *the present Year's* Date, *in the* 1770*th Year current, since* Christ, *being given?*

By the 3d *Equation*.
$Y = 1815$
$P = 1770$

The Æra, at *Julius Cæsar*'s reforming the *Calendar* 45 required. current bef. Chr.

OF ÆRAS beginning and DATES, BOTH SINCE CHRIST.

PROPOSITION III. *To determine the Years*, Y, *of an Æra*, Æ, *beginning at a given Date* Julian *Style, since Christ, answerable to a given present Year's Date* P, Julian *Style, since Christ, and thence to give other* chronological Rules.

RULE. By the latter of the two *chronological Scales*, it is evident, that, *If* you deduct the whole Years, of a *Date* at the Beginning of an *Æra*, from the whole Years of a *present Date*, the Difference in *whole* Years will be the whole Years complete since that *Æra* began; and consequently 1 Year added thereto, will be the whole Years current of that *Æra*; which are completed at the Return of the same *Month-day*, since Christ.

HENCE, we have these EQUATIONS.
1. $P - Æ + 1 = Y$
2. $Y + Æ - 1 = P$
3. $P - Y + 1 = Æ$
Julian Years current.

☞ *In the Account of Time, by the* Julian *Period, all other Rules are reduced to these Equations.*

REDUCTION of CHRONOLOGY.

EXAMPLE 1. *To find the Number of the* Julian *Year current*, Y, *of the* Turkish Hegira, *whose Æra*, Æ, *began in the 622d Year current since Christ, answering to the present Date*, P, *1765 current, since Christ?*

By *1st Equation.*

$$P = 1765$$
$$+ 1$$
$$1766$$
$$Æ = 622$$

Julian Year of the *Turkish Hegira*, . . 1144 *current* since Christ, required.

EXAMPLE 2. *To find* P, *the present Date current since Christ, from the Year*, Y, *of a given Æra* 1129 *Years* Julian *of the* Persian Jesdegird, *current; the Beginning of which Æra*, Æ, *being in the 632d Year current, since Christ?*

By *2d Equation.*

$$Y = 1129$$
$$Æ = 632$$
$$1761$$
$$- 1$$

Present Year *Julian* since Christ, P = 1760 required. current.

EXAMPLE 3. *To find the Date*, Æ, *since Christ, of the Beginning of an Æra, from* Y, *the Years of that Æra*, 1477, *current since it began; and* P, *the present Year's Date, in the* 1760 *Year current, since Christ, being given?*

By *3d Equation.*

$$P = 1760$$
$$Y = 1477$$
$$283$$
$$+ 1$$

The *Æra* of Martyrs, or *Dioclesian Æra* . . 284 required. current since Christ.

☞ *Those who desire greater Exactness than this near Way of answering these chronological Cases, by whole Years current, may apply the Years and Days complete, of one Æra, at the Commencement of other Æras.*

PROPOSITION IV. *To determine the* Julian *Years and Days* complete *betwixt any two given* Dates?

RULE I. Take the Difference betwixt the Dates in complete Years and Days, being both before, or both since, Christ.

RULE II. Take the *Sum* of the *Dates*, in complete Years and Days, being one *Date* before and one *Date* since Christ.

BOTH DATES BEFORE CHRIST.

	Yrs.	Ds.	
EXAMPLE 1. *Alexander the Great* died in the 324th Year current, *before Christ*, on the 12th of *November*	323 .	315	complete.
Julius Cæsar reformed the *Calendar*, in the 45th Year current, before Christ, on the 1st of *January*	44 .	0	complete.
Diff.	279 .	315	complete.

Therefore, when *Julius Cæsar* reformed the *Calendar*, it was in the 280th *Julian* Year current or 279th *Julian* Year and 315 Days *complete*, of the *Æra* of *Alexander's* Death.

By PROP. I. *Equat.* 1.

$$\begin{rcases} Æ = 324 \\ P = -45 \end{rcases} \text{Yrs. current before Christ.}$$

$$279 + 1 = 280 \text{ Year current.}$$

ONE DATE BEFORE AND ONE SINCE CHRIST.

	Yrs.	Ds.	
EXAMPLE 2. The *Foundation of Rome*, in the 753d Year current, before *Christ*, on the 21st Day of *April*	752 .	254	complete.
Turkish Hegira, begun in the 622d Year current, since Christ, on *July* 16 . . .	621 .	196	complete.
Sum	1374 .	85	complete.

Therefore, the *Turkish Hegira* (see *Tab. p.* 129.) commenced on the 1375th Year *current* of the *Building of Rome*, or on the 1374th Year and 85th Day thereof, *complete.*

By PROP. II. *Equat.* 1.

$$\begin{rcases} Æ = 753 \text{ current } before \\ P = 622 \text{ current } since \end{rcases} \text{Yrs. Christ.}$$

$$1375$$

	Yrs.	Ds.	
EXAMPLE 3. The *Æra* of *Martyrs*, or *Dioclesian*, began in the 284th *Julian* Year current since Christ, on *August* 29 . .	283 .	241	complete.
The *Æra* of the Reformation of the *Julian* Calendar by Pope *Gregory* began in 1582 since Christ, on *October* 5	1581 .	278	complete.
Dif.	1298 .	37	complete.

Therefore, the *Gregorian Æra* commenced in the 1299th *Julian* Year current of the *Æra* of Martyrs, in the 1298th Year thereof and 37 Days *complete.*

By PROP. II. *Equat.* 1.

$$P = 1582 \text{ Yrs.}$$
$$Æ = 284 -$$
$$1298 + 1 = 1299 \text{ Years current [since Christ.}$$

N. B. *Hence the Truth of the foregoing Rules, for answering* chronological Questions, *in whole Years, are proved.*

☞ *When the Days complete, in any* Julian *Date, are less than those, in another* Julian *Date to be taken from them, you must subtract* 1 *Year from the Answers, in whole Years current, had from the Equations, for the true whole Number of Years current.*

☞ By taking the Years and Days *Difference complete* betwixt any *former* and succeeding *Dates*, you may reduce the *Julian Account* of Time to any other Account of Time you please, in *Years* and *Days*, and the *contrary*: Especially by a Table of the Days in the Years and Months, *according to the new Account; like what is done in Page* 350 *foregoing.*

PROPOSITION V. *To reduce Olympiads into Olympic Years, either complete or current?*

RULE. Subtract 1 from the current *Olympiads* for the *complete* Number thereof; multiply the *Remainder* by 4, *adding* thereto 1 less than the Number of the odd Olympic Years current for the Number of the Olympic Years complete.

EXAMPLE 1. *In the 3d Year of the 16th Olympiad.*

$$- 1$$
$$15 \times 4 = 60$$

Add 1 less than the No. of odd Olymp. Yrs. + 2

Complete Olympic Years 62 required. Or current 63.

EXAMPLE

REDUCTION of CHRONOLOGY.

EXAMPLE 2. *In the 1st Year of the 195th Olympiad current?*

— 1

$194 \times 4 = 776$ Years complete.
Or *current* 777.

☞ *Now, these Olympic Years,* Y, *being given since the* Æra *of the* Olympiads, Æ, 776 *Years current before Christ, began, are reduced into* P, *the present* Date, *before or since Christ, by the former Equations, as have been shewn, in the* I. *and* II. PROPOSITIONS.

And P, Years current given before or since Christ, may be reduced into Y, *Olympic* Years, from the Olympic *Æra*, beginning 776 Years current *before Christ*; and then those *Olympic* Years, Y, may be reduced into *Olympiads*, and *odd* Years *complete* and *current*, by the *Converse* of the foregoing *Rule* for reducing *Olympiads* into Olympic Years, as follows.

RULE. For *reducing Olympic Years* complete into OLYMPIADS. Divide the Olympic Years complete by 4, and the *Quotient* will be the Olympiads, *complete*; to which add 1, for the Olympiads current: Then add 1 to the *Remainder* for the odd *Olympic Years current*.

EXAMPLE 3. 63 Olympic Years *current*.

complete.
4)62(15 + 1 = 16 *Olympiads* current.
60

2 + 1 = 3 *Olympic* Years *current*.

Olympiads are reduced into *Olympic* Years, Y, and then into Years of the *Julian Period*, P, by considering the *Æra* of Olympiads, Æ, beginning its *Æra* in the 3938th Year of the *Julian* Period; coming under PROPOSITION III. and *Equation* 2.

EXAMPLE 4. *To find the present Year,* P, *of the* Julian *Period, answering to the* 2490th *Year,* Y, *current of the Olympic Æra,* Æ, *that begun in the* 3938th *Year current of the* Julian *Period?*

By Prop. III. *Equat.* 2.

Y = 2490
Æ = 3938

6428
— 1

Current Years of the *Julian* Period, required P = 6427

CONTRARILY, P and Æ being *given*, Y the Olympic Years are thence *found*, and may be reduced to *Olympiads* and Years *Olympic*, complete and current.

PROPOSITION VI. *To find the Cycles of the* Sun, Moon, *and* Indiction, *answering to the* Olympiads?

RULE. Reduce the *Olympiads* to the Olympic Years, *current*, add thereto 17, 4, and 7, and divide by 28, 19, and 15, respectively, and the remaining Numbers will be those of the respective Cycles, *required*.

EXAMPLE. *To find the respective Cycles to the 3d Year of the 623d* Olympiad, *or* 2491 *Olympic Years current.*

28)2508(89 . . . . 19)2495(131

Cycle ☉ . . 16 *Cycle* ☽ . . 6

15)2498(166

Indiction . . 8 required.

For, 2491 + 17 = 2508
+ 4 = 2495
+ 7 = 2498

Answering to the 1715th *Julian* Year current since Christ.

☞ *The* Olympic Year, *commencing in* July, *the Moon after the Summer* Solstice, *has 2 Cycles, answering to two successive Years of the* Julian *Period, (each commencing with* January*) the former Cycle belonging to the* first, *and the latter Cycle to the* last, *Half of the same Olympic Year.*

PROPOSITION VII. *To find the Number of* Egyptian *Years current, of* Nabonassar, *answering to any* Julian *Year current, since Christ, O. S.?*

RULE. Add 747, (the Date of the *Julian* Year current before Christ, when the *Nabonassar-Æra* began, on the 26th of *February*, being on the 1st Day of the *Egyptian* Month, *Thoth*) to the present *Date*, since Christ; and the *Sum* thereof will give you the Number of *Julian* Years since that *Æra*; *(by Prop.* II. *and Equat.* 1.*)*

NOW, *Subtract* from which *Sum* 2 (because the 747th Year before Christ is the 2d Year after *Bissextile*) and divide the Remainder by 4, to discover the Number of *Bissextiles* happening since that *Æra*; then *add* the Number of Days expressed by the *Quotient*, (or 1 more if Nothing remains) to the preceding Number of *Bissextile* Years, and the Result thereof will give the *Egyptian* Years *required*; complete to the last Return of the same *Month-Day*, on which the *Æra* began; when those Years begin to be current.

But the *Plus* Days, above a Year, or Years, of 365 Days, must be reckoned back from the 25th of *February*, at Noon, to find the Month-day in the *Julian* Style, to which the *Commencement* of the *Egyptian* Year is now *fallen back*. This is easily performed by the Help of the *Table*, *P.* 129.

And, *If the Number of the* Egyptian *Year and Month-day thereof be required for any* Julian *Month-day preceding, or following, that on which the Æra of* Nabonassar *began,* you must deduct, or add, the preceding or succeeding Number of Days thereof, respectively, from and to the before found Days which the *Æra*'s Commencement has fallen back, in this *Julian* Account, and you will have the Number of the *Egyptian* Years and Days current, *required*, correspondent to the *Julian Month-day* and Year given.

☞ *If Nothing remains, after the* Julian *Years, less* 2, *are divided by* 4, *then* 1 *must be added to the Quotient, for the true Number of* Bissextiles.

EXAMPLE. *To find the Number of* Egyptian *Years,* Y, *of the* Æra *of* Nabonassar, Æ, *commencing* February 26, *in the* 747*th Year* Julian *current, before Christ, answering to* P, *the present* Date *of* July 16, 1760, current *since* Christ, Julian, *or* O. S.?

By PROP. II. *Equat.* 1.

P = 1760
Æ = 747

Y = 2507 current.
— 2

4)2505(626
Rem. 1

1 Year *Egyptian* . . — 365

Days to be reckoned back fr. *Feb.* 26, the Æra's falling back, 261

From *February* 26, to *July* 16, forward . . Days 140

401

Years 2507 *Julian.*
Years + 2 *Egyptian.*

1 *Egyptian* Year — 365

Years 2509 *Egyptian*, reqd. and 36 Days since that Year's Commencement; being the 6th *Day* of the Month *Paophi*, current.

Days . . 36

REDUCTION of CHRONOLOGY.

	Days	
But, (by *Tab. P.* 129) to *February* 25 . . .	56 —,	in a com. Yr.
To be reckoned back	261	in both Yrs.
To be reckoned back in the preceding Year	205 —	
	365	
Corresponding with the 9th of *June*, in the Year of Christ 1760, on which the *Egyptian* Year now begins	160	reckoning forward.
From whence reckoning . .	140	Days *more* forward.

October 27, 1760, *Julian*, O. S. . . 300, by *Tab. P.* 129. On which, *July* 16, in the 1st *Egyptian* Year of *Nabonassar*, now happens, by falling back, in the *Julian* Account.

N. B. *The Month-day of any* Julian *Year, before Christ, may be determined in the same Manner, on which any Month-day of the 1st* Egyptian *Year of* Nabonassar *happens; only, instead of adding* 747 *to the Date (as directed) since Christ, you must now subtract the Date before* Christ *from* 748, *to find the* Julian *Year current of the* Nabonassar Æra; (by PROP. I. Equat. 1.) *and then subduct* 2 *from the Remainder, which Result must then be divided by* 4, *to find the Number of Bissextiles; and so proceeding to find the* Egyptian *Year current, and the Month-day of the* Julian *Year, on which its Commencement falls back, as before.*

OTHERWISE. *To find the* Egyptian *Year and Month-day current of the* Æra *of* Nabonassar, *commencing* February 26, 747 *Years current before Christ, answering to the Date of the Christian* Æra, *of* July 16, O. S. 1760, *current, or* July 27, 1760, N. S.

DATE SINCE CHRIST.

Jul. Yrs. comp.	Days.
1000	365250
700	255675
56	20454
3	1095
Julian Years 1759 complete.	
June, complete . .	181
In *July*, Days *complete* . .	15
Since Christ, to the present Julian *Date* . .	642670
Before Christ, at the *Æra* of *Nabonassar* . .	272785
Sum . .	915455 Days [*complete.*
	Days.
Egyptian Years 2000 . .	730000 —
	185455
500 . .	182500 —
	2955
8 . .	2920 —
Egyptian Years 2508 complete, and . .	35 Days [comp.
Thoth, complete	30— comp.
Paophi	5 Day [comp.
Viz. in 2509 *Egyptian* Years current, on	6 Day of *Paophi. Current.*

ÆRA BEFORE CHRIST.

Julian Yrs comp.	Days.
700 . .	255675
44 . . .	16071
2	730
Julian Years 746 complete.	
From the 25th of *Feb.* to the Years End	309 *complete.*
Before Christ, at the Beginning of the *Æra* of *Nabonassar* . .	272785 Days complete.

☞ *Mr.* Ferguson, *in his Astronomy, has given us* August 29, O. S. *on which the first Day of the* Egyptian *Month* Thoth *happened*, (and which we have also observed) *but he has not given us the Year of Christ, or Year of the* Julian *Period, nor any Point of Time, when this Event happened, which we have here* † *supplied below.*

REMARK. The Beginning of the *Æra* of *Alexander the Great*, on *November* 12, on the 324 *Julian* Year current, before Christ, was on the 1st Day of the *Egyptian* Month *Thoth*; as also was the Beginning of the famous *Æra* of *Nabonassar*, so well known among the ANTIENT ASTRONOMERS; because King PTOLEMY, and the *Rest*, adjusted all their *Astronomical Computations*, by the Years of that *Æra*, according to the *Egyptian Style*, so very fit for their Purpose.

Likewise, the Beginning of the *Æra* of Martyrs, or of the *Dioclesian Æra*, on *August* 29, in the 284th † *Julian* Year, current, since Christ, fell on the 1st of the *Egyptian* Month *Thoth*; which is the *Egyptian Æra* given us by Mr. *Ferguson*, in his *Astronomy*; though he has not given us the Julian *Date*, or Year, correspondent.

☞ *Those who would reduce any* Date, *or Year of an* Æra, *in the* Julian *Style, before or since* Christ, *to the* Year *and* Month-day *of any other Æra, (and the* contrary) *according to the* Difference *between the* Julian *and* Egyptian *Years, must follow the foregoing* Rules *of the* VII. PROPOSITION, *(and the* Converse *thereof,* Mutatis Mutandis).

THUS have we completed THE WHOLE BUSINESS OF CHRONOLOGY, (as promised in former Pages) so far as relates to the *calculative or most useful Part*; to which the *historical Part* is *only* wanting, to perfect the Subject, with which *our Astronomy* is so closely connected. *See Sir* If. Newton's *Chronology*.

INTRODUCTION TO THE COMMENT ON THE MOON's THEORY.

I. DEFECT *of* ASTRONOMICAL TABLES, *constructed from* OBSERVATIONS.

1. Such Tables in vain.

2. Unfit for the Purpose of Navigation.

TO gain, from *Observation*, such a complete Knowledge of the *lunar* Motions, as to be able from thence to frame *Tables* accurately enough to represent the Moon's true *Place*, or *Longitude*, in every Point of her Orbit, during an entire Revolution of her *Apogeon* and *Node*, through the Space of near 19 Years, has hitherto proved ineffectual Labour. For, though the *lunar Tables* framed, from Time to Time, from such *lax* and *sparing* Observations, as the Astronomers of the *last Century* contented themselves with making, agree sometimes, even in the *Octants* and *Quadratures*, surprizingly with the Heavens, yet, in *general*, it has happened much otherwise. And they have been found to deviate, so widely, from Observation, that no Use can be made of them *for obtaining the Longitude to the Degree of Exactness necessary for the Purpose of Navigation:* Not even the celebrated *Tables* of Dr. *Halley*, imperfectly founded on the *Theory* of the great Sir ISAAC NEWTON.

II. DEFECT *of* TABLES *supplied by* OBSERVATIONS.

3. Regular Returns of Inequalities, in the lunar Periods.

YET this Defect, as this great Astronomer, Dr. *Halley*, observes, is not the Fault of the *Art*, but of the *Artificer*. For, by observing the *Period* of the *lunar* Inequalities, which is performed in *eighteen* Years and *eleven* Days, or two Hundred and *twenty-three* LUNATIONS, it is found that the Return of ECLIPSES, and other *Phænomena* of the Moon's Motion, are very regularly performed. That whatever *Error* is found in a former *Period*, the same is again repeated in a succeeding one, under the like Circumstances, of the Distance of the *Moon* from the *Sun*, and of the *Sun* from the Moon's *Apogeon*.

4. Number of Observations required to make correct Tables.

But, then to gain a *certain* and *distinct* Notion of all these *Irregularities*, which, from Observation, throughout this *Period*, disturb the *lunar Motions*, would not only exceed the Power of any one Person, in the short Duration of his Existence, but would necessarily be the Work of Ages to perform; it requiring no fewer than 194400 *Observations* to complete the *lunar Theory*; being $= 360 \times 60 \times 9$; that is to every Minute in the *Zodiac*, for one Revolution of the *Apogeon*.

☞ Dr. Halley, *to correct the Computation from his* Tables, *has given an* Abacus *of the Errors observed, throughout one Period, joined to a correct* Series *of Observations from whence they are deduced.*

III. *Of* TABLES CONSTRUCTED *according to the* THEORY.

ON the other Hand, to deduce the Theory of the Moon, *à priori*, or to shew, from the Laws of *Gravity* and *Attraction*, the Manner in which the Motion of a *Satellite*, revolving round its Primary, is disturbed by the Sun, is, the *Quantity* of that disturbing Force, and its Proportion to the *centripetal* Force, by which it is retained in its *proper*

Orbit,

INTRODUCTION to the COMMENT.

Orbit, with the Nature and Quantity of the Errors thence arising, both in *Longitude* and *Latitude*, is an Attempt, which neither the *Mathematicians* of remote Ages, or those of more modern *Date*, since the Revival of Learning in the *West*, have made the Object of their Studies and Inquiries. This wonderful *Exertion* of the Powers of the Mind, greatly beyond what the human Understanding has before been thought equal to, was reserved for *Newton*. For *Him* it was destined to raise the *English* Reputation in the *cœlestial Sciences* above that of other Nations, and to teach the admiring World, the *true Causes* of the Order and Harmony observed throughout our PLANETARY SYSTEM.

> " *Discimus hinc tandem, quâ causâ argentea Phœbe*
> " *Passibus haud æquis, graditur: cur subdita nulli*
> " *Hactenus astronomo, numerorum fræna recusat:*
> " *Cur remeant nodi; curque auges progrediuntur.*"
>
> Halleius in Newtonum.

1. *Discovery and Honour of the Moon's Theory, Sir* Isaac Newton's.

Every *Englishman* who values his Country, and who is emulous of having its Reputation eminently raised in the Opinion of other Nations, for the Progress made in every Branch of *Literature*, and of *Philosophy* in particular, must *venerate* the Name of *Newton*, for establishing that Reputation on the most solid Foundation. And there are *few* who will blame this Attempt of making him more *universally* known and understood upon a Subject, the most useful of any in the Science of Astronomy; though the most perplexing and difficult to understand! I mean the true Theory of the *lunar* Motions, deduced from the Theory of Gravity by our *great Mathematician!*

IV. ACCOUNT of the SUBSEQUENT COMMENT.

2. *Principles of the Moon's Theory.*

IN the *Progress* of the subsequent *Comment*, the COMMENTATOR has endeavoured to be clear as well as concise: closely following Sir *Isaac Newton*'s Arguments. He has traced out from thence the general *Principles* on which the several *Theorems* are established, and from whence the different *Problems* are deduced, without entering into the *fluxionary Method* in their Solution: giving only, in general, the *Result* of the Computations, as they are derived from the *Principles of Motion*. To have gone *further*, had been, at once, to copy all that our Author has wrote upon this *Subject*, who reasons too *closely* for his Reasoning to be *abridged*, and too *clearly* for giving the Sense of his Subject in *fewer* or *fitter* Words. What is here attempted, will, I hope, answer the Purpose for which it is given the Public. It is intended as a *Foundation for better lunar Tables* than yet have been published; such as may properly be called TABULÆ *verè* NEWTONIANÆ. And these Tables *deviate* only in very minute Particulars from the Theory, as Sir *Isaac* left it; having but three † *additional* Equations; except the *Equation* which corrects the Moon's *Variation*, according to her Anomaly, may be admitted as *additional* also; which cannot entirely be so esteemed, as our *Author* himself points it out to the Consideration of future Astronomers.

3. *Design of the Comment and Tables.*

4. *Three Equations only added to the Moon's Theory.*

S. C.

† *These* three *additional Equations are reduced to* One. *For the* VI *and* VII, *are only different Parts of the same Equation, and the latter Part Supplemental of the* First. *And the* IX, *or* Evection-*Equation, is no other than the second Equation of the Apogeon, and of the* Eccentricity, *transferred to the Moon's Anomaly, or, indeed, is but a Part of the* whole central *Equation, according to* Newton; *the* Mean *Central being the other Part.*

AN

AN

Explanatory Comment

ON THE

MOON's THEORY.

According to which PRINCIPLES, the Aſtronomical TABLES at the BEGINNING of THIS WORK (preceding the SUPPLEMENTAL TABLES) are CONSTRUCTED.

I. *Of the* MOON's MOTION.

1. Moon deſcribes Areas round the Earth nearly proportionable to the Times.

IN eſtabliſhing the *Theory of the Moon*, from the Laws of *centripetal* Forces, as laid down in the *firſt Book* of the *Principia*, our *Author* firſt conſiders the Moon as revolving round the Earth, in the ſame Manner as the Earth, or any other of the *primary* Planets, revolves round the Sun; and from the *Phænomena*, or obſerved *Motion*, or *Diſtance* of the Moon, demonſtrates, that the Moon, in revolving round the Earth, preſerves that eſtabliſhed Law of Motion, in deſcribing *Areas proportionable to the Times*, no leſs than the primary Planets in their reſpective Revolutions round the Sun: neglecting however thoſe inconſiderable Errors which ariſe from the Action of the Sun upon the Moon in her Orbit.

2. Law of the Moon's Motion, and of her centripetal Force.

Our Author next obſerves, that the Force, by which the Moon is retained in her Orbit, tends towards the Earth, agreeable to the *Law of centripetal Forces.* (B. I.) And alſo, that the Force is, *reciprocally, as the Squares of the Diſtance from the Earth's Center*; as is the more evident from the very ſlow Motion of the Moon's *Apſides*, amounting but to 3° 3′ at a mean Rate in one Revolution of the Moon.

He *further demonſtrates*, that the Moon gravitates towards the Earth, and by that Force of Gravity is continually drawn off from a *rectilinear* Motion, and thereby retained in her Orbit. This *Property* of the Moon's Motion is partly to be deduced from the *foregoing Propoſition*; but more extenſively from the following *Theorem*, which ſhews, that the *Force*, by which ſhe is retained in her Orbit, is no other than that which we call *Gravity*, and by which all Bodies are made to deſcend towards the Earth.

3. Moon's Diſtance from the Earth, and her Gravitation.

The correct mean Diſtance of the Moon from the Earth, according to Obſervation, is 60 $\frac{1}{2}$ of the Earth's *Semidiameters*. Let us, ſays our *Author*, aſſume the *mean* Diſtance of 60 Semidiameters in the *Syzigies*; and ſuppoſe one Revolution of the Moon, in reſpect of the *fixed Stars*, to be completed in $27^{d}\ 7^{h}\ 43'$, as Aſtronomers have determined; and the *Circumference* of the Earth to be equal to 123249600 *Paris* Feet, as the *French* have found by Menſuration. And, now, if we imagine the Moon, deprived of all revolving Motion, to be let go, ſo as to deſcend towards the Earth, with the *Impulſe* of all that Force, by which ſhe is retained in her Orbit, ſhe will, in the Space of one Minute of Time, deſcribe, in her Fall, 15$\frac{1}{2}$ *Paris* Feet. For, the *verſed Sine* of that Arc which the Moon, in the Space of one Minute of Time, would, by its *mean* progreſſive Motion, deſcribe, at the Diſtance of 60 *Semidiameters* of the Earth, is *accurately* 15 *Feet*, 1 *Inch*, and 1 *Line* $\frac{4}{9}$. Wherefore, ſince that Force, in approaching the Earth, increaſes *in the reciprocal duplicate Proportion of the Diſtance*, and upon that Account, at the Surface of the

COMMENT on the MOON's THEORY.

Earth, is 60 x 60 Times greater than at the Moon; a *Body*, in our Regions, falling with that Force, ought, in the Space of one *Minute* of Time, to describe 60 x 60 x $15\frac{1}{2}$ *Paris* Feet; and in the Space of one *Second* of Time $15\frac{1}{2}$ *Paris* Feet: And, with this very Force, we actually find Bodies, here upon Earth, do really descend. For, a *Pendulum*, oscillating *Seconds*, in the Latitude of *Paris*, will be 3 *Paris* Feet and $8\frac{1}{2}$ *Lines* in Length, as *Huygens* has observed: And the Space which a heavy Body describes, by falling, in one *Second* of Time, is to Half the Length of the *Pendulum*, in the *duplicate Ratio of the Circumference to the Diameter of a Circle*, and is therefore 15 *Feet*, 1 *Inch*, and 1 *Line* $\frac{7}{9}$. And, therefore, the *Force*, by which the Moon is retained in her *Orbit*, becomes, at the very Surface of the Earth, equal to the Force of Gravity, which we observe in heavy Bodies there. And hence the Force, by which the Moon is retained in her Orbit, is that very same Force which we call *Gravity*, and no other. For, were Gravity another Force, different from that, then *Bodies* would descend to the Earth with the *joint Impulse* of both Forces, and descend with double Velocity, and in one *Second* of Time described $30\frac{1}{6}$ *Paris* Feet, *altogether against Experience*.

4. Descent of Bodies near the Earth's Surface, applied to the Moon's Gravity.

5. Gravity of all Bodies proved.

OUR AUTHOR thus demonstrating, that the Moon is retained in her Orbit by *Gravity*; and, by *Analogy* of Reasoning, explaining likewise to us, that the same Sort of Force retains the *Primaries*, and all their *Secondaries*, in their respective Orbits; he refers us, *next of all*, to those *Principles* already laid down, from the *Theory of Gravity*, in the *first Book*, as the Foundation on which the *lunar Theory* is built. And observes, that all the Motions of the *Moon*, her *Apogee*, and *Nodes*, are to be derived from thence, as well as the *Inequalities* of those Motions from the Action of the Sun upon the *Earth*, the Primary, as well as on the *Moon*, the *Secondary Planet*.

6. Moon's Motions and Inequalities derived.

The several *Inequalities* of the Moon, from a *mean* Motion, shall be considered, when we have attended to that *Proposition*, (B. III. 25.) which assigns the Quantity of the *solar Force* on the Moon, by which her Motion round the Earth is *accelerated* or *retarded*. For, having the Quantity of that *disturbing Force*, and the Proportion it bears to that by which it is retained in its Orbit, we shall know better *how to compute the lunar Inequalities*, and to find the Agreement of the *Computation* with *Observation*.

II. *To* FIND *the* FORCES *with which the* SUN *disturbs the* MOTION *of the* MOON.

IN the annexed *Figure* (see *Prop*. 25. B. III.) let S represent the *Sun*; T, the Earth; P, the Moon; A, C, B, D, the Moon's Orbit: In SP continued take SK, equal to ST, and let SL be to SK, in the *duplicate Ratio* of SK to SP; draw LM parallel to PT; and if SK or ST represent the *accelerative* Force or Gravity of the Earth towards the Sun (*for on Account of the Smallness of the Angle* PST *these Lines may be esteemed equal to each other*) then SL will represent the *accelerative* Force of the Moon towards the Sun, when at P. But, that Force is compounded of the Parts SM, and LM; of which the Force LM, and that Part of SM, represented by TM, disturb the Motion of the Moon. For, as the *Earth* and *Moon* are revolved about their common Center of Gravity, the Motion of the Earth will be also disturbed by the like Forces. But we may consider the Sums of both the *Forces* and *Motions*, as in the Moon, and represent the *Sum* of the Forces by the Lines TM and LM. The Force LM in its *mean Quantity*, is to the *centripetal Force*, by which the Moon is retained in its Orbit, revolving round the Earth, supposed at Rest, at the Distance PT, *in the duplicate Proportion of the periodical Time of the Moon about the Earth, to the periodical Time of the Earth about the Sun*, that is, in the duplicate Proportion of $27^d\ 7^h\ 43'$ to $365^d\ 6^h\ 9'$: or as 1,000 to 178725, or as 1 to $178\frac{29}{40}$. But, the *mean Force* LM, is to the Force of Gravity on the Surface of our Earth, (assuming the Moon's mean Distance to be $60\frac{1}{2}$ Semidiameters of the Earth) as 1 x $60\frac{1}{2}$ to 60 x 60 x 60 x 178725, or as 1 to 6380926; whence, the *Proportion* of TM, LM, TM, is also given.

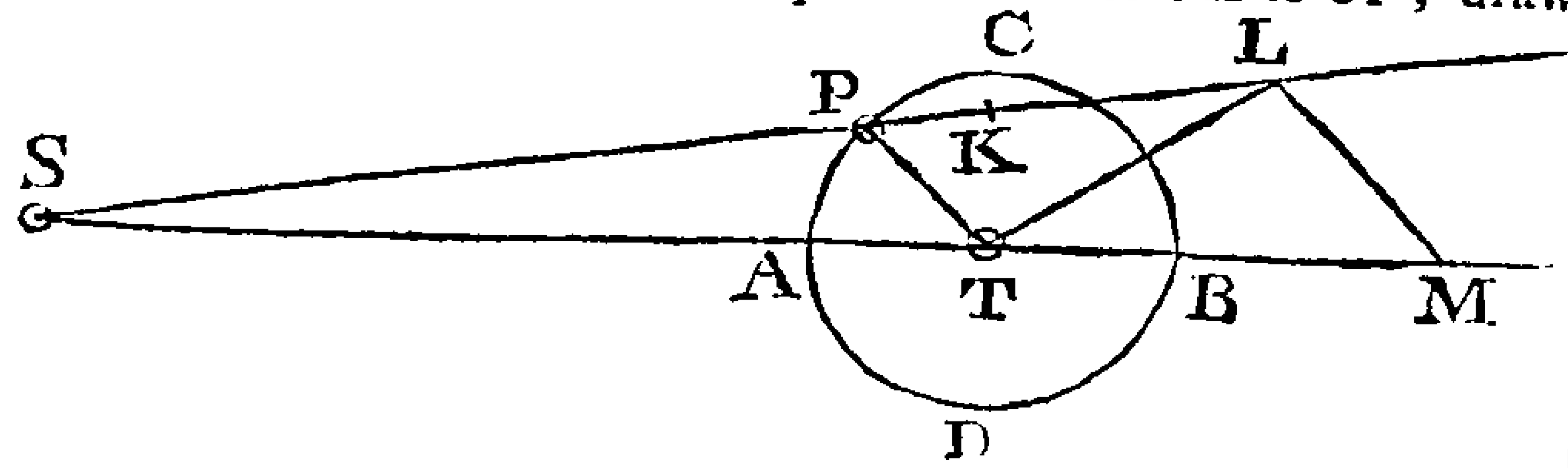

Fig. I.

1. Solution of the Problem.

2. Solar Force to that which retains the Moon in her Orbit, determined.

For, by *Prop*. IV. *B*. 3. *If both the Earth and Moon were revolved about their common Center of Gravity, the mean Distance of one from the other* would be *nearly* $60\frac{1}{2}$ *mean Semidiameters of the Earth; and the Force by which the Moon may be kept revolving in its Orbit about the Earth* Quiescent, *at the Distance*, PT, *of* $60\frac{1}{2}$ *Semidiameters of the Earth, is to the Force by which it may be revolved at the same Time, at* 60 *Semidiameters, as* 1 x $60\frac{1}{2}$ *to* 60; *and this Force is to the Force of Gravity with us very nearly, as* 1 *to* 60 x 60.

The Proportion of the *solar Force* to that which retains the Moon in her Orbit being thus given, the *next Thing*, to be inquired into, is the Manner in which this *solar Force* affects the Moon's Motion, and the *Change* it produces in the *Form of the lunar Orbit*; which are included in the following *Propositions* and *Theorems* of this *Third Book*.

III.

COMMENT on the MOON's THEORY.

III. *To determine the* SOLAR FORCE *producing the* CHANGES *and* INEQUALITIES *in the* LUNAR ORBIT.

1. A Deviation from equal Areas described in equal Times, by the Moon.

SIR *Isaac Newton* has demonstrated (*Prop.* XXVI. *B.* 3.) that the Areas, which in equal Times are described by the Moon, in the *Syzigies* and *Quadratures*, are to each other, *respectively*, as 11965 to 11865, supposing the Earth *quiescent*, and the Moon performing one Revolution in $27^d\ 7^h\ 43'$. But the *Synodical Month* consists of $29^d\ 12^h\ 44'$, therefore, the *Increments* of the Motion must be enlarged in the same Proportion; and the Moment of the Area in the *Syzigie* will be to the Moment of the Area in the *Quadrature*, as 11073 to 10973.

2. Properties of Motion, in a System of 3 Bodies, explained.

But, to understand more *fully* those *Principles* on which these *Propositions* are established, we must go back to the FIRST BOOK of the PRINCIPIA, where, in the *second Corollary* of *the 66th* PROPOSITION, Sir ISAAC NEWTON deduces, that in a SYSTEM of THREE BODIES, T, P, S, (see Fig. I.) If the *accelerative* Attractions *of any* two *of them, towards a* Third, *be to each other reciprocally, as the Squares of the Distances, the Body* P, *revolving round* T, *will describe its Area* swifter *near the Conjunction* A, *and the* Opposition B, *than it will in the* Quadrature C, *or* D. For, every *Force*, with which the Body P, is acted on, and not the Body T, and which does not act in the Direction of the *Line* PT, does either accelerate, or retard the Description of the *Area*, according as it is directed in *Consequentia*, or *Antecedentia*: such is the Force TM. *This Force*, in the Passage of the Body P, from C to A, is directed in *Consequentia* of its Motion, and therefore accelerates it; then as far as D, in *Antecedentia*, retards it; then in *Consequentia*, as far as B, the Motion is again *accelerated*. And, *lastly*, from B to C, in *Antecedentia*, is again retarded. Therefore, *cæteris paribus*, the Planet P must move *swifter* in the Conjunctions than in the Quadratures.

Hence also the Orbit of the Body P, (*Cor.* 4. *Prop. same*) *cæteris paribus*, is more *curved* at the Quadratures than at the Conjunction and Opposition; for the *swifter* Bodies move the *less* they deflect from a strait Line. And, besides, the Force KL, or TM, is contrary, at the *Conjunctions*, to the Force with which the Body T attracts the Body P; and therefore diminishes *that Force*: But the Body P will be less deflected from its *rectilinear Course* the less it is impelled towards the Body T.

Hence, lastly, (*see Cor.* 5) *cæteris paribus*, supposing the Orbit to be *circular*, the Body P recedes farther from the Body T, in the Quadratures than in the Conjunctions: For, if the Orbit is *eccentric*, its Eccentricity will be *greatest* (*see Cor.* 9) when the *Apsides* are in the *Syzigies*; and then the Body P, at the higher *Apsis*, may go farther from the Body T, placed in or near the *lower Focus*, than at the Quadratures.

3. An astronomical Paradox.

That the *Decrease* of the *centripetal* Force, at the Conjunctions, should be the *Cause* of the Body P, coming *nearer* to the Earth; and the *Increase*, of the same Force, at the Quadratures the *Cause* of the Body P receding then farthest from it, Dr. *Rutherford* observes, appears to be a *Paradox*; and to which he gives the *following Solution*.

4. Solution of the Paradox.

When the Moon, or Body P, is at A, the *ablatitious* Force is greatest of all; and the Moon, or Body P, is less impelled towards the Earth, than the Force of Gravity would impell it, and, *consequently*, it will run farther from the Earth than if the *centripetal* Force of the Earth, only, acted upon it, and therefore when it has reached the Quadrature D, will be at a greater Distance. When, on the other Hand, *it* has arrived there, the *centripetal* Force is increased by the *addititious* Force, expressed by LM. or PT. By this *Cause*, the Course of the Body P, is more *incurvated* towards the Earth; and when it is arrived at B, approaches *nearer* to it, than if the *solar Force* had not disturbed its Motion.

IV. *To determine the* RATIO *of the* DIAMETERS *of the* MOON's ORBIT *without* ECCENTRICITY.

THE *Curvature* of the Moon's Orbit, or the Proportion of the *Diameter* AB to CD, is deduced from the 28th *Prop.* of the 3*d Book* of the *Principia*, wherein Sir *Isaac* considers the Orbit *without Eccentricity*; and lays down, as his *fundamental Principle*, by which he solves this *Problem*, that the Curvature of the Orbit, described by a Body attracted in Lines perpendicular to it, is *as the Force of Attraction, directly, and the Square of the Velocity, inversely*. And estimates the Curvature of *Lines* compared with one another, according to the *evanescent* Proportion of the *Sines or Tangents of their Angles of Contact to equal Radii*, supposing these *Radii* to be infinitely diminished.

1. Solution of the Problem.

The *Attraction* of the Moon towards the Earth in the *Syzigies*, is the *Excess* of its Gravity towards the Earth, above the *solar Force*, 2. PK. by which the Moon *gravitates* more towards the *Sun* than the *Earth*; and, in the *Quadratures* the Attraction of the Moon, towards the Earth, is the *Sum of the Gravity of the Moon towards the Earth, or of* PT *and of the solar Force* KT. In the *former Case*, the Excess of the Gravity will be 178725 — 2000 = 176725; in the *latter*, the Sum of the Gravities will be 178725 + 1000 = to 179725. For, putting N = to $\frac{AT+CT}{2}$ 17825, equal to the *accelerative Gravity* of the Moon towards

the

COMMENT on the MOON's THEORY.

the Earth; the mean Force ML in the Quadratures = to PT, or TK = 1000, and the mean Force, TM, in *Syzigies*, will be equal to 3000; from which, taking the mean Force ML, there remains 2000 the Force by which the Moon is drawn from the Earth, and which *before* was called 2. PK. Now, the *Velocity* to the Moon in *Syzigies* A and B, is to the Velocity in the Quadratures C and D, as CT to AT. And the Moment of the *Area* described by the Moon in the *Syzigies*, to that described in the *Quadratures*, as 11073 CT, to 10973 AT. Taking this *Ratio* twice, *inversely*, and the former *once*, directly, and the Curvature of the Orbit in *Syzigies* will be to that in Quadrature, as 2151969 $AT \times CT \times N - 24081\, AT^3$ to 2191371 $AT \times CT \times N + 12261\, CT^3$. *Our Author*, proceeding, finds, by a *biquadratic* Equation, the *Ratio* of the *shortest* Diameter CD, of the lunar Orbit, to be to the *longest* AB, exclusive of Eccentricity, as 99281 to 100719, being the *Ratio* of the Moon's Distance in *Syzigies*, to her Distance in *Quadrature*; that is, in round Numbers, *as* 69 *to* 70.

2. Ratio of the Diameters of the lunar Orbit, without Eccentricity, determined, according to Sir Isaac Newton.

Mr. *Machin*, in his *Treatise on the Law of the Moon's Motion*, subjoined to the *English* Translation of the *Principia*, makes the Proportion of the shorter to the longer Axis of the Moon's Orbit to be as 59 to 60.

3. Ratio according to Mr. Machin.

But this *Ratio*, as he observes, is somewhat larger than the Proportion given by *Newton*; though not so large as that given from Observation by Dr. *Halley*, which is that of $44\frac{1}{2}$ to $45\frac{1}{2}$, or as 89 to 91.

4. Ratio according to Dr. Halley.

☞ The Transverse to the conjugate Diameter of the *elliptic Epicycle* (so called) of *Machin* is as 2 to 1; whose Center he supposes is carried to the *Left* round a circular Orbit, while the *Track* of the Moon's elliptic Orbit is carried round, in the Epicycle's Periphery, to the Right; describing equal Areas in equal Times, about the Center thereof; with the Epicycle's Transverse Diameter always parallel to the *Line of the Moon's Conjunction and Opposition*. The Moon is always at the remoter End of the shorter Axis of the elliptic Epicycle when in the *Quarters*; and at the near End (from the Center of the Moon's Orbit) at *New* and *Full*. See the *Figure and Explanation farther on.*

Mr. MACHIN *gives these following* SHORT *and* READY RULES *for deducing these* PROPORTIONS.

Let L be the *periodical* Time of the Moon; S, the Period of the Sun from the *fixed Stars*; M, the *synodical* Revolution of the Moon from the Earth; D, the Difference of the Periods of the *Sun and Moon*. Then the *Difference* of the *two Axes* will be to their *Sum*, as $3\,L \times \frac{M+L}{2}$ to 4 DD — SS, by the Principles of Sir *Isaac Newton*; but 3 LL to 2 SS—LL, according to *Machin*'s *Principles*: Whence SS — 2 LL to SS + LL, is his Proportion of the *less* to the *greater* Axis of the Moon's Orbit.

5. Machin*'s Rules for determining the same.*

From the foregoing *Data*, the *Diameters* of the Moon's Orbit, and the *Inequality* of the Moments of the *Area*, which the Moon, by a *Radius* drawn to the Earth, describes, our *great Mathematician* next deduces *that Inequality* called

V. *The* MOON's FIRST EQUATION *of* VARIATION *or* REFLECTION.

IT was first discovered by *Tycho Brahe*; but its true Cause never assigned, till our Author undertook to settle i from the *Principles of Gravity*.

If the Moon *(as has been supposed)* actually revolved in an *Ellipsis*, round the Earth, *quiescent*, placed in its Center, whose Diameters being as 69 to 70, and the *Areas*, by Radii drawn from the Earth's Center, were all proportionable to the Time of Description, then the *Tangent* of any Angle of its Motion, in that Orbit, would be to the *Tangent* of its mean Motion from the Quadrature, as 69 to 70. But, as our AUTHOR observes, *the Description of the Areas from the Quadrature to the Conjunction, or Opposition, is accelerated, and ought to be in such Proportion, that the Moment of the Area in Syzigies, may be to the Moment of the Area in Quadrature, as* 11073 *to* 10973. Which is readily brought to Computation, by diminishing the Tangent of this Angle from the Quadrature, in the *subduplicate* Proportion of 10973 to 11073, *that is*, in the *Ratio* of 68,6877 to 69. *Hence*, the Angle of the true Motion, from the Quadratures, will be, in the *Octants*, (when the Angle of *mean* Motion is 45°) = 44° 27′ 28″; the *Difference* between which, and the Angle of *mean* Motion, 45°, gives, for the MEAN VARIATION, at a *Maximum*, 32′ 32″. But this is, as I said, supposing the Earth *quiescent*. But as the Earth moves, and the Sun thereby is, *apparently*, carried in *Consequentia*, through the Ecliptic, the Moon, before it overtakes the Sun, describes an Angle greater than a Right-Angle, in its Progress from the Quadrature; and *That*, *in Proportion of the periodical to the synodical Revolution of the Moon*, $27^d\,7^h\,43^m$ *to* $29^d\,12^h\,44^m$. Whence, it comes to pass, that all the Angles about the Center of Motion are dilated in that *Ratio*, and the GREATEST VARIATION, which, in the former Supposition, amounts but to 32′ 32″, becomes 35′ 10″.

1. Method of determining the Quantity thereof.

2. Greatest Quantity of Variation determined according to Sir Isaac Newton.

According to Mr. *Machin*'s Principle, before laid down, the *Diameters* of the elliptic Orbit being to each other as 59 to 60, the VARIATION-EQUATION, at a *Maximum*, would be but 28′ 53″, which increased in the *duplicate Ratio* of *the periodical to the synodical Revolution*, or *in the Square of* $27^d\,7^h\,43'$ *to* $29^d\,12^h\,44'$, gives for the GREATEST VARIATION but 33′ 45″.

3. According to Mr. Machin.

Emendation. P. 359, L. 12, fr. Bot. for 1,000 r. 1000; L. 9 fr. Bot. for 178725, r. 178,725. L. 5 fr. Bot. same P. also, for, *at* the same Time, r. *in* the same Time.
P. 360, L. 5 fr. Bot. for, *more* towards the Sun than the Earth, r. *more or less* than the Earth towards the Sun.
Line 3, fr. Bot. after KT, introduce and r. *by* which the Moon is also attracted towards the Earth.

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4. *According to Dr.* Halley.

If Dr. *Halley*'s Ratio, from Obſervation, of the ſhorter to the longer *Axis*, be taken as 89 to 91, it will give the VARIATION at a *Maximum*, 38′ 12″.

5. *According to Mr.* Mayer.

Mr. *Mayer*, the Author of the *Gottingen Tables*, aſſerts, that the VARIATION, at a *Maximum*, is equal to the *Half-Angle* of EVECTION-EQUATION; that is, to 40′ 20″. But he gives no Demonſtration of this; and it appears, by the *Conſtruction of his Tables*, that the *Correction of Evection*, according to Anomaly, and the Correction of Anomaly itſelf, according to the *variable* Eccentricity, are, by him, both flung into his Variation-Equation, to raiſe it to that *Quantity*.

This Method of his is well adapted for the *Eaſe of Computation, but not to be admitted as Theory againſt the* Principles of Newton, *founded on the trueſt Geometry; which limits the Quantity, as above, to* 35′ 10″.

6. *Variation proportional to the Semi-Angle of Evection.*

By examining into *this Queſtion*, and proving, for my own Satisfaction, the Truth of theſe Computations, I have been led to enquire what certain Proportion, the greateſt mean VARIATION, 32′ 32″ (the Earth *quieſcent*) as Sir *Iſaac* has given it, bears to the *Semi-Angle* of EVECTION-EQUATION, at a *Maximum*, and have found it to be in *the duplicate Ratio of the ſynodical Revolution of the Moon from the Sun, to the ſynodical Revolution of the Moon from her Apogee.* And

7. *Proportional to* 45°.

I farther found, that the Tangent of the Angle of Variation is to the Tangent of the Angle of 45°, in the *Ratio of* 69 *to* 70, and the *Sub-duplicate of* 10973 *to* 11073, conjunctly; ſo likewiſe the Tangent of the Arg. of EVECTION is to the Tangent of the Angle of 45°, in the *former Ratio* of 69 to 70, and the ſimple Ratio of 10973 to 11073, conjunctly. Which Arg. of Evection ∠ 44° 19′ 40″ 40‴, being ſubducted from the Angle of 45°, leaves the *Semi-Angle of Evection-Equation* 40′ 19″ 20‴, nearly as before.

8. *A Remark.*

It is well worth obſerving, that as there is a *given* Difference, or Ratio, between the Angle of *Evection-Equation* and *Variation*, both being at a Maximum, ſo the *Sum* of theſe Equations ſhould be, when taken together, equal to the *correct Quantity of Equation of the Earth's Orbit*, at a *Maximum*, 1° 55′ 50″.

For the *Evection-Equation*, 1° 20′ 40″ + *Variation*, 35′ 10″, is equal to 1° 55′ 50″, the above Equation. So that the *Force by which the Curvature of the Moon's Orbit is changed, and becomes more or leſs eccentric than in its mean State, and alſo by which the Areas deſcribed are rendered unequal to one another, generates an Equation of the* Moon's Longitude proportionable *to that generated, in the* Sun's Longitude, *by the Eccentricity of the Earth's Orbit.*

OUR AUTHOR has here given the *mean* Quantity of the *Variation* only, neglecting, as he ſays, the *Difference* which may ariſe from the Curvature of the Orbit, or the ſtronger Action of the *Sun upon the Moon, when horned and new, than when full and gibbous.* In other Situations of the Earth, that is, when the Earth

9. *Variation greateſt at the mean Diſtance of Moon from the Earth.*

is near the *Aphelion* or *Perihelion*, the GREATEST VARIATION is compounded of the *duplicate Proportion of the Time of the ſynodical Revolution, directly, and the triplicate Proportion of the Diſtance of the Earth from the Sun inverſely*: and therefore, according to theſe Proportions in the *Aphelion*, the GREATEST VARIATION is 33′ 14″: in the *Perihelion*, 37′ 11″.

10. *Variation changeable at other Diſtances.*

In theſe *Computations*, our *Author* has neglected to take into Conſideration the Change which the variable *Eccentricity* of the Moon's Orbit muſt make in the VARIATION-EQUATION: leaving it for *future Aſtronomers* to determine the *Quantity thereof from Obſervation*: For, by the Moon's being *more* or *leſs* removed from the Earth, in her *Octants*, by the variable Eccentricity of her Orbit, the *Variation Equation* will become *more* or *leſs*; the *Ratio* between the *centripetal* and the diſturbing Force being *leſs* or *greater in the one Caſe than the other.* OBSERVATION ſhews that this Conſideration is not wholly to be neglected. For, *Tables* formed from theſe Principles are found to *err moſt* where this Correction of the *Variation*, according to the *Moon's Anomaly*, is greateſt; that is, when the Moon is in *Octants*, and near one of her *Apſides*.

11. *A Remark.*

It were much to be wiſhed, that Sir *Iſaac* had not contented himſelf to paſs this by, as a *Remark*, for others to improve on; but had deduced the Quantity *directly from the Theory of Gravity*. However, this *Equation* of the Moon's *mean Variation*, according as ſhe is at a greater or leſs Diſtance from the Earth, may be obtained by the following *Rule*.

The centripetal Force in the *Quadratures*, is to the accelerating Force in the *Syzygies*, as the *Sum* of the greateſt and leaſt centripetal Forces, to 3 Times their *Difference*.

Again, the accelerating Force, when the Moon is at a mean Diſtance from the Earth, is to the Difference of the greateſt and leaſt accelerating Force, when the Moon is in the *Apſides* of her Orbit, as the *Radius* is to the *Sine* of Half the mean elliptic Equation at a *Maximum*, or to the mean Eccentricity (Radius being 1) and the *Subduplicate* of the periodical to the *ſynodical* Revolution of the Moon from the Sun conjunctly.

Therefore, on the Principles of *Machin*'s Equant, as the Sum of the greateſt and leaſt centripetal Forces, is to the Difference of the accelerating Forces at each *Apſis*, ſo is the Radius to the Sine of this other greateſt Equation = 1′ 39″, *viz.* As 357,50 : ,171 :: Radius : S. 1′ 39″.

COMMENT on the MOON's THEORY.

VI. *Of the* MOON's SECOND EQUATION *of* VARIATION.

BUT there is still a *farther Change* in the *lunar* Orbit, arising from the stronger Action of the Sun upon the Moon, when *new and falcated, than when full and gibbous,* from whence arises another Equation, which Sir *Isaac* calls the *second Variation.*

The *centripetal* Force in Opposition being to the same in Conjunction as 180 to 178 *nearly*, the Moon recedes somewhat farther from the Earth, and moves somewhat slower in the Conjunction than in the Opposition. This *Force* generates a *new Equation* of mean Motion, which *adds* to it from *Full* to the *New* Moon, and *subtracts* from *New* to the *Full* Moon. And the *Sine of this Equation is to Radius as* ,2 *to* 357. Mr. *Whiston*, for explaining this Equation, erroneously distinguishes between an *arithmetical* Point of true, and *geometrical* Point of mean, Motion; by which he endeavours to give the Laws of this Equation; but as this Distinction of his two Points is without sensible Difference, his Reasoning is inconclusive. Sir *Isaac Newton* gives the *Maximum* of this Equation at 2′, as it is retained in the *Tables*. But by the foregoing Analogy it comes out no more than 1′ 56″.

But then this *second Equation* of *Variation* has been observed, Sir *Isaac* says, to be liable to Change. For, when the Sun is in *Conjunction with the Apogeon of the Moon*, it is, according to *our Author*, about 1′ *greater*, and as *much less*, when in Opposition; on Account of the variable Eccentricity of the *lunar Orbit: The solar Force being greater in one Situation and less in the other.*

1. *Change of the 2d Variation.*

Dr. *Gregory*, who first published this *famous Theory* to the World, gives us a very perplexed and confused *Account of this Equation*; nor had Sir *Isaac Newton* himself Observations sufficient to speak of this *Change* with Certainty. In his *First Edition* of the *Principia*, he says, that the *changeable Quantity* is to be determined by the *Situations of the Apogeons of the Sun and Moon*; and is greatest when they are in Conjunction, and least when in Opposition: It is *least* also when in Quadrature with each other, and *greatest* also when the Moon's Apogeon is in Conjunction with the Sun; but whether less in Opposition to the Sun, Dr. *Gregory*, *Leadbetter*, and others, tell us, that our *Author* could not determine, *for Want of Observations.* But this supposed Change, in this *Equation*, is not from the mutual Situation of the *Apsides*, or of the Sun, in Regard to the higher or lower *Apsis* of the Moon's Orbit; but of the Moon in respect to her Distance from the Earth; and is, in Truth, not an Increase or Decrease of this *second Variation*, but of the first only; and from the Principles deduced, in the foregoing Paragraph, to which the Reader is referred back.

2. *Controversies about the 2d Variation.*

VII. *Of the* MOTION *of the* MOON's APOGEE, *or* APSIDES.

FROM *the 7th and 8th Corollary of the 66th Proposition of the 1st Book.* Our Author derives the Motion of the Moon's Apogeon. The *Inequalities* of which Motion are, as he observes, very great, and generate the *principal Equation of the Apogee.*

From what follows, it will appear evident, that the *Line of the Apsides* must have, on the whole, a progressive Motion: but very irregular. For, when the *Moon's Apogee* is in Conjunction and Opposition with the Sun, the Apogee goes forward at the *greatest Rate*: but, when in Quadrature with the Sun, it even goes backward. For, in the Quadrature, the Force by which the Body P. (*see Fig.*) is urged to the Body T, the Force MT, then vanishing, is compounded of the Force ML and the centripetal Force with which the Body T attracts the Body P. The *first Force*, ML, is increased, *nearly*, as the Distance. The other decreases in a *duplicate* Proportion of that Distance. Therefore the *Sum* of these two *Forces* decrease in a less Proportion than the duplicate. Whence the *Line* of the *Apsis*, (by the 1. *Coroll.* of the 45th *Prop.* of the *1st Book*) will recede. In the Conjunction and Opposition, the *centripetal* Force is as the Difference of the Force KL, and PT; which, because KL is nearly increased as the Distance PT, decreases in *more than a duplicate Ratio* of that Distance; and therefore causes (*Cor.* 1. *Prop.* 45. B. I.) the Apsides to go forward. But, since the Force KL, in the Syzigies, is nearly twice the Force LM, in the Quadratures, the *Excess* will be on the Side of the Force KL; and, by Consequence, the *Line of the Apsides* will, on the whole, be carried forward.

1. *Irregular Motion of the Apsides explained.*

Sir *Isaac Newton* does not determine the Quantity of this progressive Motion of the Moon's *Apsis*, from the *Theory of Gravity*, the *Solution* he gives of the PROBLEM, "TO *find the* MOTION *of the* APSIDES (see *Prop.* 45. "*Probl.* 31. *B.* 1.) *in* ORBITS *nearly* CIRCULAR," accounts, when applied to the Moon's Orbit, but for Half the Quantity of the progressive Motion of the *Apsis* in one *Revolution*, *viz.* 1° 31′ 28″, nor has Mr. *Machin* succeeded better. He tried what it would do, *considering the Cause of this Motion as arising from the Variation of the Moon's Gravity to the Earth, as it revolves in the elliptic Epicycle, aforementioned*, for ascertaining its true *Quantity*: the Difference of the *Forces* being, in that Case, double the former; but it gave not the Quantity of Motion with that *Exactness* as was requisite: *Nor was there any Method, he thought, upon commonly received Principles, sufficient for this Purpose.*

Nevertheless, this *Problem* has lately been very satisfactorily solved by the Rev. Mr. *Patrick Murdoch*, (see *Phil. Transactions*, V. 47, P. 62) by which *Solution* he determines the Quantity in a synodical Month to be 3° 17′ 28″, exceeding the Motion by the *Tables* but 4″. And he observes, that the *Reason*, that other Authors have failed in giving the true Quantity of Motion of the *Apogee*, from Sir *Isaac*'s Principles, is, that they all have considered the Earth as *quiescent*; although the Case, in Nature, and to which they mean to apply Sir *Isaac's Rule*, is

2. *Problem solved and Quantity of the Motion of the Apsides determined by the Rev. Mr.* Murdoch.

different. For, as this *learned Writer* observes; "*The Earth and Moon revolve round their common Center of Gravity,* "*their Distance from which being inversely, as their Masses, and the Forces by which each is attracted by the other, as also* "*the Forces of the Sun to disturb their Motion being in the same* Ratio; It follows, *that the Earth in its Motion round the* "*common Center of Gravity, will suffer these Disturbances every Way similar to those of the Moon: and the whole Motion* "*of the* Apsis, *resulting from the two disturbing Forces, will be, nearly, double of what either of them could produce sepa-* "*rately round a fixed Center.*"— So far this *Author.* And whoever considers *the Solution* of this difficult *Problem,* will not only be satisfied of this Gentleman's great Abilities, but join in his Conclusion from it: That in this, as in the other *Phænomena of the cælestial Motions, the Principles and Rules which Sir* Isaac Newton *lays down are fully confirmed and verified.*

Mr. *Machin,* however, has deduced the Motion of the *Apogee* from other *Principles,* which he has not explained, but contented himself with giving *Rules* founded thereon, for obtaining *the mean Motion of the Apogee,* its *Equation and the Change of Eccentricity:* which are these that follow.

3. *Quantity of* ☽'s *Apogee, in a sydereal Year, according to Mr.* Machin's *Rules.*

"*That the mean Motion of the Moon, from its Apogee, is to its mean Motion, in the subduplicate Proportion of* 8235 *to* 8376, *or as* 1877 *to* 1893. According to which Proportion the Motion of the Apogee, in a *sydereal* Year, ought to be 40° 40′ 40″ $\frac{1}{2}$.

4. *According to Sir* Isaac's *Theory.*

In Sir *Isaac*'s Theory the Numbers stand at 40° 40′ 43″. According to *Tycho Brahe* 40° 40′ 47″.

VIII. *To determine the* CHANGE *of* ECCENTRICITY *of the* MOON'*s* ORBIT.

1. *Eccentricity determined.*

THE *least is to the mean Eccentricity, in the duplicate Ratio of the periodical Time of the Sun's Revolution, to the mean synodical Time of its Revolution from the Moon's Apogee: which* Ratio *is nearly as* 107 *to* 136.

2. *Greatest 2d Equation of the Moon's Apogee.*

LASTLY, for the SECOND EQUATION of the APOGEE — "*The Sine of the greatest Equation is to the* Radius, *as the Difference of the greatest and least Eccentricities are to their Sum;* that is, *as* 29 *to* 136. This determines the *Maximum* of this Equation at 12° 18′ 43″ 16‴. Sir *Isaac* has determined it from Observation to be 12° 18′. And the *Rule* I have already given, for determining the *Semi Equation of Evection,* assigns it the same Quantity.

3. *Mr.* Machin's *Rule for determining the Eccentricities of the Moon's Orbit, and correcting the lunar Theory.*

Mr. *Machin* also makes Mention of *another Rule,* derived from a *different Method,* which presupposes the Knowledge of the mean Eccentricity, and which, he says, would not only determine the *variable Eccentricity* with greater Exactness; but would also correct the *modern Theories* of the Moon in a Particular, wherein their greatest Error, he says, seems to consist: *that is,* in *placing the Earth in the lower Focus of the Ellipse, which the Moon describes in her Revolution round the Earth;* whereas, it ought, HE SAYS, "*to be in a certain Point more near the Perigeon.*" What these Principles were from, whence he derived this Correction, or how he founded this *new Hypothesis,* it is not possible to collect from this *Sketch,* or *Abstract* of a larger Work intended; *He having given no* Data *for our Guide,* in his short *Treatise on the Moon's Gravity.*

IX. CHANGE *of the* INCLINATION *of the* MOON'*s* ORBIT; *With the* RETROGRADATION *of her* NODES, *explained, and determined in a circular and elliptic* ORBIT.

BUT, it is not only the Motion of the Moon, as to *Longitude,* which is affected by these *disturbing Forces:* The *Inclination of her Orbit* likewise suffers Change by them, and her *Nodes,* (or the *Points, where the Orbit of the Moon intersects the Plane of the Earth's Orbit*) are carried with a *retrograde* Motion, through every Point of the Ecliptic. The *Causes* of these *Changes* are explained in the *10th and 11th Corollaries of the 66th Prop. B.* 1. Principia. The *Summary* of which Explanation is as follows.

1. *Change of the Orbit's Inclination described.*

LET the *disturbing Forces* be represented, as in *Fig.* I. by the Lines TM, ML. It is evident, that this last Force, acting in the Plane of the Moon's Orbit, never can disturb the Motion as to Latitude; and that the former Force, TM, when the *Nodes* are in *Syzygies,* acting also in the same Plane of the Orbit, cannot, at that Time, affect these Motions. But, when the *Nodes* are in Quadrature, it must disturb them very much. For attracting the Moon perpetually, out of her Orbit, it *diminishes the Inclination of the Plane thereof in the Passage of the Moon from the Quadratures to the Syzygies;* and *again increases the same in her passing from the Syzygies to the Quadratures.* Hence, the Inclination is *least* of all, when the Moon is in *Syzygies,* and returns to the *first* Quantity, nearly, when the Moon arrives at the *next Node.*

The Moon being thus, *perpetually,* drawn from the *Plane of her Orbit,* it is manifest as she continually recedes from that *Plane,* in her Passage from C, *that* she will intersect the *Plane of the Earth's Orbit,* not in the opposite Node D, *but in some Point more near to* S, which, from thence, becomes a *new Place* of the Node, in *Antecedentia* to the former Place. The *Nodes* therefore, when near the *Quadratures,* recede perpetually; but, in the *Syzygies,* where no disturbing Forces act in the same Plane, are *quiescent;* and in *intermediate* Places, recede with a quicker or more slow Motion, as they are nearer to the one Point than the other.

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Our Author has computed the Quantities of these *Irregularities*, which take no less than FIVE PROPOSITIONS in the III. BOOK. It would be difficult to render such an *abstruse Subject* clearer than in the Words of the *Author*, or to explain the Grounds of his Computations so, as to give more Satisfaction. *Let* it suffice to trace out the *Steps* he proceeds in. And *first*, He begins with the LEAST DIFFICULT PROBLEM, *To find the* HORARY MOTION *of the* NODE *in a* CIRCULAR ORBIT?

(See *from Prop.* 30 *to* 35 *inclusive.*)

In which he observes, that, of the two Forces, by which the Moon's Motion is disturbed, that which is represented by the Line MT alone (*Vide Fig.* I.) generates the Motion of the NODES. And that this Force is the same with 3 PK, which (by *Prop.* 25) is to the Force, by which the Moon may be in its *periodic Time carried in a Circle round the Earth at Rest*, as 3 PK *to the Radius of a Circle multiplied by the Number* 178,725, *or as* PK, *to the Radius thereof multiplied by* 59,575. Since, therefore, these Forces are the one to the other, as 1 to 59,575, this mean horary Motion of the Moon being $32' 56'' 27''' 12^{iv} \frac{1}{2}$, in respect of the fixed Stars, or a periodical Revolution, the horary Motion of the Node will be $33'' 10''' 33^{iv} 12^{v}$, when the Nodes are in *Quadrature* and the Moon in *Syzygies*. In other Cases, the horary Motion of the Node will be to $33'' 10''' 33^{iv} 12^{v}$, as the Product of the *Sines* of the Moon from the Quadrature, of the Moon from the Node, and of the Node from the Sun, to the Cube of *Radius*. If therefore the *Nodes* went on with that Velocity throughout, which they acquire at first, the Moon being in *Syzygie*, (for then the Force PK is at a *Maximum*) *they would describe a Space, double to what they do, in Fact*: but the *mean* Velocity, between this, their greatest Velocity, and their *total Quiescence* (when the Moon is in the Quadrature and the Force PK vanishes) being half this Quantity, their *mean* horary Velocity in a circular Orbit will be $16'' 35''' 16^{iv} 36^{v}$, when the Nodes are in *Quadrature*. In all other Positions, the *mean* horary Motion of the Node, will be to $16'' 35''' 16^{iv} 36^{v}$ as the Square of the *Sine* of the Distance of the Nodes from the Syzygies, to the Square of *Radius*.

2. *Quantity of the horary Motion of the Moon's Node, in a circular Orbit determined.*

Sir *Isaac Newton* next considers what the Quantity would be in an *elliptic Orbit* whose Diameters were to each other as 70 to 69, and the *Increments* of the Areas as 10973 to 11073. And he finds, that, in such an Orbit, *the horary Motion of the Nodes, in Quadrature, will be diminished to* $16'' 16''' 37^{iv} 42^{v}$: To which the mean horary Motion of the Nodes in any other Position is proportional as the Square of the *Sine* of their Distance from Syzygy to Square of Radius. But LASTLY,

3. *The Quantity determined in an elliptic Orbit.*

THE ANNUAL MEAN MOTION of the NODES is the *Sum* of *all the* HORARY MOTIONS. And the Motion in a complete Course of a *sydereal Year*, or of $365^{d} 6^{h} 9'$, amounts to $39^{\circ} 38' 7'' 50'''$. But this also, *by Prop.* 33, is to be diminished in the Proportion of the *Rectangle of the Circumference multiplied by the* Radius, *to the Area of the Circle, or of* 2 *to* 1. So that the annual Motion of the *Node*, in a *sydereal* Year, is half the above Quantity, equal to $19^{\circ} 49' 3'' 55'''$. Which Quantity must also be diminished; it being computed on the Supposition that the Sun passes through the whole Circle, or 360°, from its leaving one *Node* to the returning to it again. Whereas by the *Regress* of the *Node* it will have passed through but $340^{\circ} 11'$. The *mean Motion* therefore, still wants a farther Diminution. The Quantity of this Diminution is assigned, by *our Author*, at $1^{\circ} 29' 58'' 2'''$, which subtracted from the above Quantity, leaves $18^{\circ} 19' 5'' 53'''$, for the *whole Motion of the Node in respect of the fixed Stars between two of its next Conjunctions with the Sun*: which afterwards increased in Proportion of $341^{\circ} 41'$ to 360°, gives $19^{\circ} 18' 1'' 23'''$ *for the mean Motion of the Node in one sydereal Year*. Observations determine it at $19^{\circ} 21' 21'' 50'''$; but this Difference, *our Author* imputes to the *Excentricity* of the *lunar* Orbit, and its Inclination to the Plane of the Ecliptic.

5. *Annual Motion of the Nodes determined.*

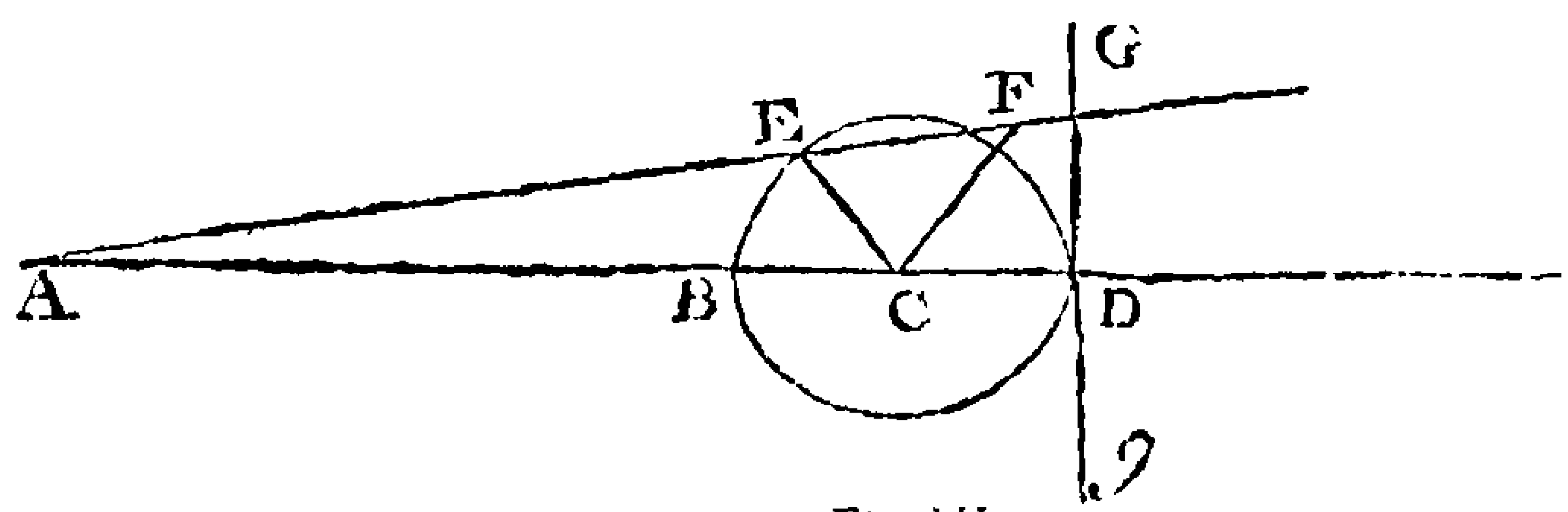

Fig. III.

From these *Inequalities*, in the Motion of the Node, Sir *Isaac* deduces the PRINCIPAL SEMI-ANNUAL EQUATION *of the* NODE. Its true Place may be had, in every Aspect of the Sun. About the Center C, describe the Circle B, E, F, D, produce CD, to A, so as AB may be to AC, *as the mean Motion of the Node, to the half of the true Motion when in Quadrature with the Sun.* That is, as $19^{\circ} 18' 1'' 23'''$ to $19^{\circ} 49' 3'' 55'''$. So that BC, be to AC, as *the Difference of those Motions*, $0^{\circ} 31' 2'' 32'''$, to *the latter of them* $19^{\circ} 49' 3'' 55'''$, or *as* 1 *to* $38\frac{3}{10}$. Then, through the Point D, let the *indefinite Line* Gg, be drawn, touching the Circle in D. Next, if the Angle BCE, or BCF, is made equal to the *double Distance* of the Sun, from the *Node*, and the *Line* AE, or AF, be drawn, cutting the Tangent Line GD, in G, and we also take another Angle, which shall be to the whole of the Motion of the Node, in the *Interval* between the *Syzygies* (that is to $9^{\circ} 11' 3''$) as the *Tangent* DG, to the *whole Circumference* of the Circle, BED, and we *add* the last Angle, for which the Angle DAG may be used, to the mean Motion of the *Nodes*, whilst they are passing from the Quadratures to the *Syzygies*, and *subtract it*, whilst they are passing from the *Syzygies* to the Quadrature, *we shall have their true Motion.* And *the Equation resulting thence will be, at a* Maximum, $1^{\circ} 29' 45''$.

1. *Method of determining the 2d Equation of the Node.*

2. *The greatest semi-annual Equation of the Moon's Node determined.*

XI. *The*

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XI. *The* QUANTITY *of* INCLINATION *of the* MOON's ORBIT, *with the* ECLIPTIC, *deduced from Her* HORARY VARIATION.

1. The Horary Variation.

Our Author further computes, from the ſame Principles, the *Horary Variation* of the Orbit's Inclination to the Ecliptic, and gives a Method of computing the Quantity of Inclination at any given Time.

The *Mean Variation* of the Inclination of the Orbit is given at $16' 23'' \frac{1}{2}$; but this is *abſtracted* from the Conſideration of the Moon's Situation in her Orbit. For, if the *Nodes* are in Quadrature, the Inclination is *more* by $2' 43''$, the Sum of the Horary Increments, than when in *Syzigie*; and the whole Mean Variation $16' 23''$, diminiſhed by half that Quantity, $= 1' 21'' 30'''$, becomes $15' 1'' 30'''$, when the Moon is in *Quadrature*: And being increaſed, by the ſame becomes $17' 44'' 30'''$, when the Moon is in *Syzigies*. If therefore the Moon be in *Syzigies*, the WHOLE VARIATION, in the Paſſage of the *Node* from the Quadratures, to the Syzigies, will be $17' 44'' 30'''$, or rejecting thirds, $17' 45''$. And therefore, if the *Inclination*, when the Nodes are in *Syzigies*, be $5° 17' 20''$, it will be $4° 59' 35''$ when they are in Quadrature, and the Moon in Syzigies: Obſervation confirming the *Accuracy* of all theſe Computations.

2. The Greateſt Variation of the Inclination of the Moon's Orbit, determined.

3. Mr. Machin's *Determination of the ſame Quantities nearly.*

Mr. *Machin* derives the ſame Quantities, *nearly*, by a *different Method*, as Sir *Iſaac* gives; but as the Proportions, for forming his *Elliptic Equant*, are the ſame with thoſe Sir *Iſaac* has given, it is unneceſſary to ſay more of it here. Our *Author* thought it worthy of a Place in the *Scholium* to theſe *Propoſitions*, though the Method of computing from this *Elliptic Equant* was, at the ſame time, found out by Dr. *Pemberton*, who made uſe of it for the ſame Purpoſe: the *Inveſtigating* the *Motion* of the *Nodes*. I ſhall refer the Reader for *further Inſtruction*, as to this Method, to *Machin's Theory of Gravity*, which is founded on the known Properties of the Figure he applies to that Purpoſe. That, where equal Areas are deſcribed in equal Times, about the Center of the *Elliptic* or *any other Equant*, the Rays, from the Center, are *always reciprocally in the Subduplicate Ratio of the Velocity about the Center.*

4. The Inveſtigation of the Moon's Nodes according to Machin.

THE *Foregoing* are the PRINCIPLES, from which our AUTHOR has given the LUNAR THEORY, *à Priori*; ſhewing how the IRREGULARITIES, in the *Motion of the Moon*, may be derived from PHYSICAL CAUSES. What is farther *wanted* to *compleat it*, and *reduce thoſe* IRREGULARITIES *to Computation*, is ſupplied in the SCHOLIUM *to the* FOREGOING PROBLEMS.

XII. *Of the* SOLAR FORCES, *acting on the* MOON, *in her* ORBIT.

1. The Sun produces the Inequalities of the Moon's Motions by Turns.

WE have been ſufficiently inſtructed, already, that the *Irregularities*, in the Moon's Motion, proceed from the diſturbing Forces of the *Sun*, which *increaſe and diminiſh*, *by Turns*, *the* Areas [illegible]; and which, *were* that *diſturbing Force taken away*, would, like the Areas, deſcribed by the primary Planets, round the Sun, *be equal or proportional to the Times of Deſcription.*

2. The Force of the Sun on the Moon's Orbit according to the different Diſtances.

It is alſo evident, that the *Action* of the Sun upon the Moon's Orbit, muſt be increaſed or diminiſhed, according to the leſs or greater Diſtance of the Sun from the Earth. And as the *Ablatitious* Forces are double thoſe of the *Addititious*, nearly, that the Orbit of the Moon muſt be more, in general, *dilated*, and its Periodical Revolution round the Earth more ſlowly performed, than if theſe *Forces* had not diſturbed her Motion at all. Theſe *Ablatitious Forces* increaſe and decreaſe in the *Triplicate Ratio of the Sun's apparent Diameter*. For they are, *as the Square of the Diſtance of the Sun, inverſely*, and the *Diſtance of the Moon from the Earth, directly*. In this Proportion therefore, is the Orbit of the Moon *dilated* in the Perihelion, and *contracted* in the Aphelion. The Orbit of the Moon being thus by Turns *dilated* and *contracted*, ſhe takes a longer Time to perform her Revolution in the *dilated* than in the *contracted* Orbit. The Quantity of this *Irregularity*, and of the *Equation* thence generated, is determined by Sir *Iſaac*, from *Cor.* 6. *Prop.* 66. *B.* I. Wherein he demonſtrates that *the periodical Time of the Moon, will be increaſed and diminiſhed, in a Ratio compounded of the ſeſquiplicate Ratio of the increaſing and decreaſing Radii, and of the ſubduplicate of that Ratio in which the Earth's central Force is diminiſhed, or increaſed, by the Increaſe or Decreaſe of the Sun's Action upon the Earth.* From which

3. Proportional Change of the Solar Forces diſturbing the Moon's Motion.

4. Change of the Lunar Orbit explain'd.

XIII. *The Greateſt Annual* EQUATION *of the* MOON,

1. Greateſt *Annual Equation.*

According to Sir *Iſaac Newton* is $11' 49''$: The *Eccentricity* of the *Orbis Magnus* being to the *Radius*, as 1687 *to* 10 000. But Obſervation ſhews this to be ſomewhat too large; for if this Equation were farther diminiſhed in the *ſubduplicate Ratio* alſo of the *ſynodical* to the *periodical* Times, its *Maximum* would be (to the above given Eccentricity 1687) $= 11' 29''$ with which Obſervation more nearly agrees. If we aſſume a leſs Eccentricity for the Earth's Orbit, *viz.* 1685, or as much as ſhall correſpond to $1° 55' 50''$, for the Equation of the Sun's Center, the *annual* Equation of the Moon will be $11' 25''$ only, as by our Tables; ſomewhat greater than given by *Mayer* in the *Gottingen* Tables.

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Mr. *Machin*, ſubſtituting an *Equation* which ſhall be to the *Sun's Equation*, as the mean Solar Force, to the Force of the Moon's Gravity, or as 47 to 8400; and increaſing that *Equation*, in the *Ratio* of the *Sun's Period*, to the mean *Synodical Period of the Moon from the Sun*, or of 99 to 8, computes *this Equation* at 12′ 5″. *Horrox* gives its *Maximum* 11′ 30″.

2. *Mr.* Machin's *greateſt Quantity of the* Annual *Equation of the Moon.*

But, the *Solar Force*, on the Moon's Orbit, which acts in a *Triplicate Ratio* of its Diſtance from the Earth, *inverſely*, not only affects the mean Motion of the Moon, but generates *Equations* both in the Mean Motion of the *Apogee*, and *Nodes*: They being *accelerated as the Mean Motion of the Moon is retarded, and retarded when that is accelerated.* For, though the *Equation* of the Nodes is to be *ſubtracted*, when that of the Moon's mean Place is likewiſe *ſubtracted*, yet it is, in Fact, an Acceleration of the Motion of the *Nodes*, which is Retrograde in Itſelf. For, determining the Quantity of theſe Equations. The MOTION of the SUN is, *in the reciprocal duplicate Ratio of its Diſtance from the Earth*: This Motion generates, (the Eccentricity of the Orbit, being $16\frac{11}{12}$ to 2000 its M. Diam.) an Equation of the Center, which, at a *Maximum* is = 1° 56′ 20″. If the Motion of the Sun had been in a *Triplicate Ratio*, the Equation thence generated would have been 2° 54′ 30″. Therefore, the *greateſt Equation* of the Apogee and Node is to 2° 54′ 30″, as the mean *diurnal* Motion of the Apogee, and of the Node, reſpectively, is to the mean diurnal Motion of the Sun, Hence

XIV. *The* GREATEST EQUATION *of the* MOON's APOGEE,

Is 19′ 43″, and the GREATEST EQUATION OF THE NODE 9′ 2[illegible]″. But the greateſt EQUATION OF THE SUN being but 1° 55′ 50″, the *Annual Equations* of the *Moon's Apogee* and *Nodes* will be reduced to 19′ 38″ and 9′ 21″, *reſpectively*, as in the Tables.

Mr. *Machin's* RULE, derived from his *Elliptic Equant*, is, that if the Sun's Force is in a *Triplicate Ratio* of the Sun's Diſtance, the Rays of the *Equant* ſhall be in the *Seſquiplicate Ratio of the Diſtance*. That, if the Revolution of the Motion, to be equated, was performed in the Time of the Sun's Revolution, *its Equation* would be to *the Equation of the Sun's Center*, nearly as 3 to 2. Or if the Force decreaſed as *m*, any other Power of the Sun's Diſtance, the Equation would be to that of the Sun's Center as *m* to 2. But, if the Motion be performed in any other *Period*, any ſmall annual *lunar Equation*, ariſing from the different Diſtance of the Sun, at different Times of the Year, would then be *more* or *leſs*, in the *Ratio* of the *ſynodical Revolution of the Sun from the Motion to be equated, to the periodical Revolution of that Motion to be equated.* THIS RULE makes the *greateſt Equation* of the *Node* 8′ 56″; of the Apogee, 21′ 57″.

1. *Mr.* Machin's *Rule for determining the greateſt Equation of the* Apogee *and* Nodes.

2. *Mr.* Machin's *greateſt Equations thereof.*

Theſe three *Annual Equations*, according to *Newton*, bear ſuch Proportion to the *Central Equation* of the Earth, that when *that* is greateſt, the *Reſt* are ſo; *and when that is diminiſhed, the Reſt will be diminiſhed proportionably.* For the Sun's greateſt Equation is to the greateſt Equation of the Moon, Moon's Apogee, and Node, reſpectively, as the preſent Equation of the Sun to the preſent Equation of the Moon, Apogee, and Node, reſpectively.

XV. *A* SECOND EQUATION *of the* MOON's ORBIT.

By the *Theory of Gravity*, Sir *Iſaac Newton* found, that the Moon's Orbit was alſo ſomewhat more *dilated* when the Sun and Moon's *Apſides* were in Conjunction, than when at Right Angles with each other; which *Difference* ariſes from the Orbit being the *moſt* Eccentric and Elliptical in the *Former* Situation, and *leaſt* of all in the *Latter*. From hence the *Mean Motion* requires a *farther Correction*, the Moon moving *ſlower* in a *wider* Orbit, and *ſwifter* in the more *contracted* one. This *Equation* our Author determines, from Obſervation, to be 3′ 45″, at a mean, when the Sun is in *Octants* with the Moon's *Apſides*: at other Times, it is to that Quantity, *as the Sine of the double Diſtance of the Apſides, from the neareſt Syzygy or Quadrature, is to the Radius.* Its *leaſt* Quantity in the Aphelion of the Earth is 3′ 34″; and its *greateſt*, in the Perihelion, 3′ 56″: being in the reciprocal triplicate *Ratio* of the Sun's Diſtance from the Earth.

1. *The greateſt Quantity of this Equation determined.*

Though our *Author* deduces this from Obſervation, alone, yet the Quantity may be deduced from the following Analogy: *That is, the Sine of this Equation is to the Sine of the greateſt ſecond Equation of the Moon's Apogee, in the duplicate Ratio of the ſynodical Time of the Moon from the Sun, to the ſynodical Time of the Sun from the Moon's Apogee.* By this RULE the Equation comes out 3′ 40″

2. *Whence this Equation derived.*

☞ The ſynodic Time of the Sun from the Moon's Apogee = 412^d.786; Moon from Sun 29^d.53; Greateſt ſecond Equation of the Moon's Apogee = 12° 18′.

XVI. *A* THIRD ANNUAL EQUATION *of the* MOON.

From the *Laws of Gravity*, our *Author* has likewiſe deduced a *Third Annual Equation* of the Moon's Motion from the Situation of the Sun with the *Nodes*. For the *Solar Force* being ſomewhat Greater on the Lunar Orbit, when they

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1. Its greatest Quantity determined.

are in Conjunction with the Sun, than when in Quadrature, there arises a *small Equation* from this different *Dilatation* of the Orbit, as the Sun and Nodes are situated in respect of each other. Which *Equation* he has computed, *(for it is too small to be determined by Observation)* to be at a *Maximum*, in the *Octants*, 47″. At other Times, it is to this Quantity, *as the Sine of the double Distance of the Sun from the Node, is to the Radius. At other Distances, in Octants, as Cube of Sun's Distance from the Earth: and therefore in* Perigee 49″, *in* Apogee 45″.

2. Otherwise determined.

The mean Inclination of the Moon's Orbit being 5° 8′ 28″, and the half Difference of the greatest and least Inclination 8′ 52″, this Equation will be to the Sine of the half Difference as the Sine of the mean Inclination to the Radius. For the Force by which the Moon is drawn from the Earth being lessened in the Ratio of the Cosine of the Inclination of the Moon's Orbit to *Radius*, this Equation of mean Motion, generated by the Increase or Decrease of that Force, as the Sun is in Conjunction or Quadrature with the Moon's Nodes, will be as the *Sines* of that *Difference* to the *Sines* of the mean Inclination, making the *Radius* of the Circle which the Moon describes, according to her mean Motion, or while the Sun is in *Octants* with the Nodes, equal to 1. By which *Rule* that Equation comes out 48″, nearly.

Both these Equations *add to the mean Motion, whilst the Sun passes from the Quadrature,* with the Apsides and Nodes, *to their Conjunctions,* and *subtract from it, in its Passage from the Conjunctions to the Quadratures. The* GIVEN QUANTITY of this *last*, like the former Equation, is to be *increased or diminished in the Ratio of the Cubes of the Sun's Distance from the Earth inversely.*

XVII. THE SECOND *and* GREATEST EQUATION *of the* MOON's APOGEE.

By the same *Theory of Gravity*, our *Author* deduces the *second* and *greatest Equation of the Apogee*. We have already spoken of it in explaining the Motion of the *Apsides* from 7, 8, and 9 *Corollaries of Prop.* 66. *B.* 1. Its greatest Quantity, from the Theory of Gravity, as well as from Observation, is nearly 12° 18′, *and at all Times it is to that Quantity, as the double Distance of the Sun from the Apogeon is to the Radius.*

XVIII. HORROX's IMPROVEMENT *of the* LUNAR THEORY.

Horrox, as Sir *Isaac* observes, was the first Astronomer, who advanced the Theory of the Moon moving in an Ellipse, round the Earth placed in its *lower Focus*. Dr. *Halley* improved this Notion, by placing the Center of the Ellipse in an *Epicycle*, whose Center uniformly revolved round the Earth. The *Motion* in this Epicycle, expresses the forementioned *Inequalities*, in the *Progress and Regress of the Apsides*, and the *Change* in the Quantity of the Eccentricity.

1. The Eccentricity of the Moon's Orbit and 2d Equation of her Apogee, deduced.

Let the mean Distance of the Moon from the Earth, *says our Author*, be divided into 100000 Parts; and let T *(Fig. 3)* represent the Earth; TC, the Moon's mean Eccentricity = 5505 such Parts. Produce TC to B, so as CB *may be the Sine of the greatest semi-annual Equation of the Apogee,* 12° 18′ *to the Radius* TC. Then, the Circle described upon the Center C, with the Radius CB, will be the EPICYCLE mentioned, in which, the Center of the Moon's Orbit is placed, and revolved to the *Left*, according to the *Order* of the Letters, B, D, A. *Set off the Angle* BCD, equal *to twice the annual Argument,* or the *double Distance of the Sun's true Place from the Moon's Apogee, once equated.* Then, CTD will be the *second Equation of the Moon's Apogee for the Time given;* TD *the Eccentricity of the Orbit, tending to the Place of the* Apogee, *now twice equated; and* CD, or CB, *the Difference between the mean and the greatest Eccentricity* = 1173, of *the above Parts. N. B.* The Radius of the *Epicycle* CD, or CB, as seen from the Moon, at her mean Distance from the Earth, subtends an Angle of 40′ 20″, = the *Semi-Equation of Evection.* How this Angle may be obtained, at once, without computing the Angle CTD, or the Eccentricity

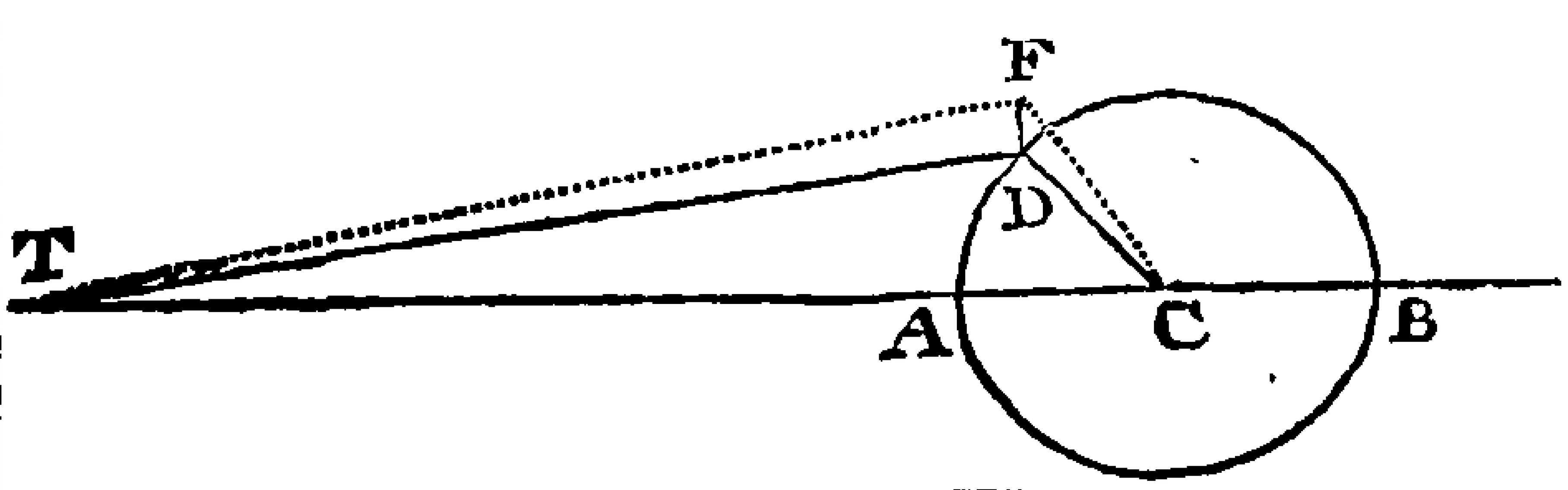

Fig. III.

2. A Reference.

TD, is fully explained in the Letter to Lord MACCLESFIELD, on the *Parallactic Angle*, to which the Reader is referred. Or you may see it performed farther on, P. 371.

But, the Moon's *mean* Place, the Place of its *Apogee*, its *Eccentricity*, the longer *Axis* of its Orbit, 200000, being given, the Moon's *true* Place in her Orbit, with her Distance from the Earth, are thence determined, by the known Method of solving the Equation of her Center.

3. Changes of the Moon's Orbit according to the different Distances of the Sun from the Earth.

In the *Computations* of the Equations of the *Apogeon*, and Change of *Eccentricity* of the Orbit, which takes Place from the different Action of the Sun upon it, according to its different Aspects, in respect of the *lunar Apsides*, no Notice has hitherto been taken *of the Diminution or Excess of Solar Force, which affects these Changes in the Orbit, according as the Sun is farther from, or nearer to the Earth.* But, as the Sun acts with greater or less Power on the *lunar* Orbit, according as the Earth is nearest to its Perihelion, or Aphelion, and that, in the *triplicate Ratio* of its Distance, inversely. It is *necessary*, that the *Excess*, or *Diminution*, of the Sun's Action, upon the Orbit, should take Place in these *Computations.* — In Order to determine *this Equation*, Sir *Isaac* thus proceeds.

XIX. THE SECOND EQUATION *of the* MOON's CENTER.

In the Perihelion of the ⊖, when the solar Force is greatest, and where there is no solar Equat. the Center of ☽'s Orbit moves *faster* about the Center C, *(see Fig.* 3) than in the Aphel. and that in the reciprocal *tripl. Ratio* of ⊙'s Dist. fr. the

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Earth. But, becaufe, in *Fig.* III. the *Equation* of the Sun's Center, at other Diftances, is included in the *annual Argument*, ½ BCD; the Center of the Orbit thence moves fafter, in its Epicycle BDA, in a reciprocal *duplicate Ratio* of thofe Diftances from the Earth. But that it might move yet fafter, round the Center C, in the reciprocal *fimple Ratio* of thofe Diftances; from the Point D, the *firft* Center of the Moon's Orbit, fet off the Point F, the fecond Center of the Moon's Orbit, making DF, to DC, as *twice the Eccentricity of the Earth's Orbit to the Sun's mean Diftance, and the Sun's mean diurnal Motion from the Moon's Apogee, to his diurnal mean Motion from his own Apogee, conjunctly:* Or, as $33\frac{7}{8}$ to 1000, and 52′ 27″ 16‴ to 59′ 8″ 10‴, *conjunctly*, or 3 to 100.

And let *the Angle* CDF *be equal to the Complement* of *the Sun's* true *Anomaly* to 360°, for *the Time given. The Line* DF *will be then* 35,2 *fuch Parts as* TC *contains* 5505, or mean Diftance of the Moon from the Earth 100000; and will fubtend an Angle, feen, at a mean Diftance, from the Moon, at Right *Angles* with that mean Diftance, = 1′ 12″ 30‴, *half* the greateft Equation; the Double of which, 2′ 25″, according to our *Author*, is the *Greateft of this Equation*, which he calls the *fecond Equation of the Moon's Center*. Which Equation may be had, at all other Times, either by fubtracting twice the annual Argument from the Sum of the Moon's equated and Sun's mean Anomaly, or elfe *by adding the Diftance of the Moon equated from the Sun, to the Diftance of the Apogee of the Moon equated from the Apogee of the Sun, for the Argument; and faying, as the Radius is to the Sine of the Argument thus found, fo is* 2′ 25″ *to the fecond Equation of the Moon's Center. To be added if the Argument is lefs than a Semi-Circle, but to be fubtracted if greater.* So fhall you have (*concludes our Author*) the Moon's true Orbit Place in the *Syzigies*: in which Computation the *Variation-Equations* are excluded.

1. Greateft 2d Equation of the Moon's Center determined.

But this wants fome farther *Explanation.*

In the preceding *Fig.* III. D reprefenting the *firft* Center of the Moon's Orbit, in the Epicycle, according to the *double annual Argument* BCD; F a new *Center*, tranflated out of that *Epicycle*, by the Excefs of the Sun's Action upon it; it is evident, that the *correct Equation* of the Apogeon is no longer the Angle CTD, but the Angle CTF; and the *Eccentricity* of the Orbit, to the Time given, will be reprefented by the *Line* TF, which, in this Situation, is greater than the former Eccentricity, TD. It appears alfo, that, the Angle FDC being the *Complement* of the Sun's Anomaly to 360°, the Point F, in the tranflated Syftem, muft, in the laft Semi-circle of the Sun's Anomaly, when the Sun's Equation adds to the mean Motion, be in *Antecedentia* to the Point D, as in the Figure before us; where the Angle of the Sun's *double Diftance* from the Moon's Apogee is no longer reprefented by DCB, but by FCB, lefs than the former by the Angle FCD. So the *firft* Center of the Moon's Orbit, D, in the untranflated *Epicycle*, will, by *doubling* the annual Argument, (in which the Sun's Equation is twice included) for ∠ BCD, be carried about, out of the *Apfides*, in the inverfe duplicate *Ratio* of the Sun's Diftance; and will therefore require a Tranflation to F, to move round C in the *fimple Ratio* of that Diftance, inverfely, correfponding with our *Author's Theory*, in this Refpect: which fhould be the *Acceleration* of the *fecond* Center F, of the Orbit, in the reciprocal *triplicate Ratio*, only, (exclufive of the encreafed Acceleration by the *redoubled* Sun's Equation) every where, as in the *Apfides*; carried in a certain Curve, about the Center C, in the tranflated Syftem, by the Means aforefaid.

2. Explanation of the Caufe of the 2d Equation of the Moon's Center.

BUT *our Author*, in this Computation, has given only the *Equation* which arifes from the *difturbing Force*, taken in the *fimple Ratio* of the Sun's Diftance, inverfely, the Sun's Equation, he fays, involved in the *Argumentum annuum*, fupplying the reft. But, this can only be underftood where that Equation takes Place. For, in the *Perihelion*, and Aphelion, of the Earth, or of 0, and 6 Signs, of the Earth's Anomaly, where the *Excefs*, or *Diminution*, of the folar Force, is at its *greateft Quantity*, there the Line DF fhould be according to the *triplicate Ratio* of the difturbing Force. If we fuppofe the Center of the *Ellipfe* to be carried about in the reciprocal *duplicate Ratio* of the Sun's Diftance, the *Equation* thence refulting, would be 2′ 44″; or, as Sir *Ifaac* has determined it, DF would be to DC, as $33\frac{7}{8}$ to 1000, and DF = 39,7. But, to obtain the Proportion of each in the *fimple Ratio* of the Sun's Diftance, he leffens this Proportion, in the *Ratio of the Sun's diurnal Motion from his own Apogee to his diurnal Motion from the Apogeon of the Moon, or in the* Ratio *of* 59′ 8″ *to* 52′ 27″, *which gives* DF = 35,2 *and an Equation of* 2′ 25″, as before. NOW, in order to obtain this Equation, in the *triplicate Ratio* of the Sun's Diftance, in the *Apfides*; DF, muft be taken to DC, as 50,85 to 1000, which Proportion will give DF 59,63, and the *Equation of the Motion*, in the tranflated Epicycle, according to the inverfe *triplicate Ratio*, = 4′ 6″, which is the true Quantity in the *Perihelion* or *Aphelion* of the Earth.

3. A Correction of the common 2d Equation of the Moon's Center.

In order to reduce THIS EQUATION, at all Times, to its *true Quantity*, we muft confider it as confifting of two Parts. LET us call thefe Parts P, and Q: The firft of thefe being the Quantity 2′ 25″, the Second of 1′ 41″. The Argument for the Equation P, will be the *double annual Argument fubtracted from the Sum of the Moon's equated and Sun's mean Anomaly*. The Argument for the Equation Q, will be the *Sun's Anomaly added to the double annual Argument, and fubtracted from the Moon's Anomaly alfo*. Both *diminifh* the Place of the Moon, if their refpective Arguments are more than *fix Signs*, and *increafe* its Longitude, if they are *lefs*. The *Sum*, or Difference, of thefe *two Quantities*, will give the *Equation affigned*, with the proper *Sign* connected; and the Center of ☽'s Orbit will then be, every where, carried in a *Curve about the Center* C, nearly, *as the Cube of the Sun's Diftance from the Earth*, inverfly

4. The true Relation of this Equation at all Times.

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XX. EVECTION-EQUATION *of the* MOON.

1. *Another Method of computing the Quantities of the same Equation.*

2. *Correction of the Evection-Equation.*

OR if, according to the *shorter Method*, laid down in the Letter to Lord MACCLESFIELD, referred to before, you compute, at once, the EVECTION-EQUATION, the respective *Arguments*, for both Parts of *this Equation*, will be for P, *the Angle of Evection + Sun's Anomaly*; and for Q, *the Angle of Evection — Sun's Anomaly*.

3. *A further Correction of the Evection-Equation.*

But, the EVECTION-EQUATION still wants a *farther Correction*, not considered by this *great Author*; which arises from the *Obliquity of the Moon's Orbit with the Earth's Orbit*. From this *Position* of the Plane of the lunar Orbit, it appears, that the Quantity of the *solar Force*, by which the Motion of the Moon is disturbed, as to *Longitude*, must be *diminished*: That *Force* requiring to be resolved into *two Forces*; one parallel, the other perpendicular, to the *Direction thereof*. It is plain, that the latter Force cannot affect the Motion as to *Longitude*; but only the former. So that, that *Force* shall be to the *whole Force*, in the *triplicate Ratio of the Cosines of the Angles of Inclination*. THE EVECTION-EQUATION diminished in that *Ratio*, will be 1° 19′ 41″, which taken from 1° 20′ 41″ Evection-Equation, the *Equation thence resulting* will be 1′; according to *Tables*.

XXI. PRINCIPLES *of the* THEORY *agree with* OBSERVATION.

1. *The Correctness of our Tables.*

2. *The Design of our Tables.*

THUS, from our *great Geometrician's Principles* of the *lunar Theory*, the lunar Equations may be deduced, *à priori*, with a Degree of *Exactness* almost equal to Observation. By *constructing Tables* from the foregoing *Data*, the Moon's Longitude may be found, at all Times, *within 2 Minutes of the Truth*, and seldom with an *Error of more than Half a Minute*. This *Theory*, as Sir *Isaac* gave it the World, *errs in no Part of the Orbit above 6 Minutes of a Degree*; and the Method of *Calculus*, to be established upon the foregoing Revisal of it, shews how *little Alteration* is necessary, to the *making Tables from thence to serve the important Purpose of Longitude at Sea*. That what is here offered, as an *Amendment*, or *Correction* of *the* THEORY, is as much intended to *reflect* Honour *upon this* great Man, *as to render* THIS WORK *of general Use to Navigation*.

XXII. *The* SUN *and* MOON's RADICAL PLACES.

FOR the Establishment of *astronomical Tables*, according to this Theory, by the Assistance of Mr. *Flamstead*, the then Astronomer Royal, Sir *Isaac Newton* fixed the following Longitudes of the Sun and Moon, as the correctest at the *Royal Observatory*, at *Greenwich*, to the last Day of *December at Noon*, *old Stile*, 1700, or *to the Beginning of* 1701: *viz.* The *mean Longitude of the Sun*, ♑ 20° 43′ 40″: Of *his Apogeon*, ♋ 7° 44′ 30″. The *mean Longitude of the Moon*, ♒ 15° 21′ 0″. Of *her Apogeon* ♓ 8° 20′ 0″; and of her *ascending Node* ♌ 27° 24′ 20″: and the Difference of Meridians, between the Royal *Observatories* of *Greenwich*, and *Paris*, is given, from Observation, at 9′ 20″. On which our eminent Author observed, that the mean Motion of the Moon, and its Apogee, were not then discovered with *sufficient Accuracy*.

XXIII. CORRECTION *and* IMPROVEMENT *of the* Lunar NUMBERS *and* THEORY.

THE *Observations* of later Astronomers, particularly of *Flamstead's* Successors, Dr. *Halley*, and Dr. *Bradley*, have corrected these *Numbers* to the wanted Accuracy. Dr. *Bradley*, one of the most accurate Observers that any Nation can boast of, has confirmed, by his Observations, an Opinion, started at first by Dr. *Halley*, and since pursued by Mr. *Mayer*, of *Gottingen*, and other foreign Astronomers, *that the mean Motion of the Moon is more accelerated in her Orbit now than in former Ages*. The Quantity of this *Acceleration* has been lately fixed at our *Royal Observatory*, for the Year 1750, at 12″, for one hundred Years before and after that *Æra*, and that the *Increase* of Acceleration, from that Time, is as the *Square of the Centuries, and centesimal Parts of Centuries, before or after that Æra*. The mean Longitudes of the *Sun*, of his *Apogee*, and the *Moon*, and of her *Apogeon*, and *Nodes*, are also made *correct* by later Observations; so that, now, in comparing *very ancient Observations with our Tables, formed by these Corrections*, the Errors are not greater, than the Rudeness and Inaccuracy of Observations, in those early Ages, will account for.

NOTE, There is this RULE (P. 299. *Scholium to foregoing Propositions, B.* III. *Newton's Prin. transf. by Motte.*) The Motion of the Sun being in the reciprocal *duplicate Ratio* of his Distance from the Earth, with Eccentricity $16\frac{11}{12}$ to mean Dist. 1000, generates an Equation 1° 56′ 20″; but moving in the reciprocal *triplicate Ratio* generates an Equat. as 2 to 3, of the former; *viz.* (2 : 3 :: 1° 56′ 20″ :) 2° 54′ 30″ *Equat.*

☞ *The Equations generated by the Sun's Mot. being directly as the* Indices *of the reciprocal generating Powers of his Distances from the Earth: the Revolutions being performed in the same Time; but if in different Time, the Equation before found will be more or less, as Time of 1st to Time of 2d Revolution; according to* Machin, P. 38, Laws of Moon's Mot. — But whether this holds true in all *Orbits* and *Indices* of reciprocal generating *Powers*, is to be doubted, or proved; taking the same or like Position, in different Orbits; or taking their *greatest Equations*, respectively.

XXIV.

COMMENT on the MOON's THEORY.

XXIV. LUNAR PROPERTIES *and* CONCLUSIONS.

IN the *Corollaries*, deduced from the 37*th Propoſition*, *Book* III. relative to the MOTION *of the* TIDES, Sir *Iſaac Newton* gives the following *Computations*.

1. *That the Denſity of the Moon is to the Denſity of the Earth as* 4891 *to* 4000, *or as* 11 *to* 9.

2. *That, ſince the true Diameter of the Moon is to the Diameter of the Earth, as* 100 *to* 365, *the Maſs of Matter in the Moon will be to the Maſs of Matter in the Earth, as* 1 *to* 39,788.

3. *The accelerative Gravity, on the Surface of the Moon, will be* 3 *Times leſs than the accelerative Gravity on the Surface of the Earth.*

4. *That the Diſtance of the Moon's Center, from the Center of the Earth, will be to the Diſtance of the ſame from the Center of Gravity, as* 40 *to* 39.

5. *The mean Diſtance of the Moon from the Center of the Earth, is* 60 *Semidiameters, and one* tenth, *in the* Syzigies; *but, in the* Quadratures, *is* 61 *Semidiameters ſubducting one* 30*th Part; which is in Proportion of* 69 *to* 70.

6. *The* horizontal Parallax, *in the Moon's Syzigies, Sir* Iſaac *gives at* 57′ 20″, *under the* Equator. *For, from the* Earth'*s being an* oblate Spheroid, *this Quantity diminiſhes, as that is receded from; and the* Parallaxes *in the Latitudes of*

tudes of	30°	38°	45°	52°	60°	90°
are . .	57′ 16″	57′ 14″	57′ 12″	57′ 10″	57′ 8″	57′ 4″.

7. *The mean Semidiameter of the Moon, as ſeen from the Earth, is, at all Times, to the Moon's horizontal* Parallax, *as* 15′ 45″ *to* 57′ 20″; *or as* ,275 *to* 1, nearly. *And its horary* Motion, *in* Syzigies, *Sir* Iſaac *ſettles at* 33′ 32″ 32‴; *in the Quadratures at* 32′ 12″. *The* greateſt horizontal Parallax, *at about* 61′ 10″; *the* leaſt, *at* 53′ 30″; *the* true horizontal Parallax *being to the Mean, in the ſimple* Ratio *of the Moon's Diſtance from the Earth,* inverſely; *and the* true horary *Motion of the Moon, to its mean Motion, in the* duplicate Ratio *of the true and mean* horizontal Parallaxes.

S. C.

OF DETERMINING THE EQUATION OF EVECTION, *referred* to in P. 368, of this WORK, as determined at P. 25 *and* 26, in a PRINTED LETTER to the EARL of MACCLESFIELD.

THIS EVECTION-EQUATION, is the *Difference* between the mean and true *central Equation* of the Moon at all Times. —

THUS, the greateſt Equation of the Moon's Center = 7° 39′ 20″ Sun in *Apſides* ☽.
The leaſt Equation thereof = 4 57 58 Sun in their Quadrature.

Hence, the greateſt *Evection-Equation* is the Difference between the greateſt mean, and the greateſt and leaſt true *central* Equation, = 1° 20′ 41″, when the Eccentricity = 55050, and mean Diſtance of the Moon from the Earth = 1000000.

Difference	2	41	22	
Half ∓	1	20	41	*Evection-Equation.*
	6	18	39	*Mean central Equation.*

At all other Times, (when the Eccentricity is more or leſs than 55050, of ſuch Parts as the mean Diſt. from the Earth = 1000000) the Sine of this *Evection-Equation*, or of the Dif. between the preſent mean and true central Equation of the Moon, is to the Sine of the greateſt Evection, 1° 20′ 41″, nearly, as the *Sine* of the *Exceſs* of the Moon's mean Anomaly, equated by ½ mean central Equation, according to its Sign, above *twice* the Sun from the Moon's Apogee, is to *Radius*. — Adding this Equation to the *Moon's Longitude* when the Argument is *more* than *ſix* Signs, and ſubtracting it therefrom when the Argument is *leſs* than *ſix* Signs.

	Logarithms.
Thus, As Radius	10.0000000
To S. Arg. Evec. 2ˢ 5° = 65° . .	9.9572757
So S. 1° 20′ 41″ Gr. Evection . . .	8.3704700
To S. 1° 13′ 7″ Preſent Evection, *nearly.*	8.3277457

	Logarithms.
Or, As Radius	10.0000000
To S. Arg. 65°	9.9572757
So S. 1° 20′ 26″ Gr. Evection . .	8.3691223
To S. 1° 12′ 54″	8.3263980

Preſent Evection *nearly*, according to our *Tables.*

OTHERWISE. *Like ſolving the central Equation of the Moon, to a given Eccentricity.* Imagine another *Ellipſis*, whoſe Semitranſverſe = the mean Diſt. of the Moon from the Earth = 100000, and each *Focus* thereof diſtant from the Center = the *Radius* of the *Epicycle* (*ſee* P. 368. *Fig.* III.) = Half of the Dif. of the greateſt and leaſt Eccentricity of ☽'s Orbit, = 1173; and the Arg. of Evection ſimilar to the mean Anomaly of the Moon, revolving about the *upper Focus*. Then there is given, the Angle of Argument at the *upper Focus*, whoſe *Supplement* is included by two Sides of a Triangle, one the Diſtance of the *Foci*, and the other = the Tranſverſe Diameter, both iſſuing from the *upper Focus*, whoſe *Sum* and *Diff.* are as the Aphelion to the Perihelion Diſtance, to find the leſs Angle oppoſite, by *Caſe* 5 *Oblique Plane Triangles*. Which Angle being doubled = the *Evection-Equation* ſought, very nearly.

		Logarithms.	
Thus, As Aphelion Diſt.	101173 co.	4.9949354	*Conſt. Log.*
To Perihelion Diſt.	98827 . . .	4.9948756	9.9898110
So Tan. ½ Arg. = Tang. ½ Sum oppoſite ∠s in the given △	32° 30′ 0″	9.8041873	To be added to the Tangent of Half the Evection-Equation.
To Tan of Half their Dif.	31 53 38	9.7939983	

Leſs Angle . . the Dif. . . 36 22
Doubled . . 1° 12′ 44″ Evection-Equation required, *nearly*, as before.

☞ If greater Accuracy is required, ſolve the elliptic Equation correctly, by the *general Method*, P. 96.

D. *Cowper* directs this Equation to be increaſed or diminiſhed, in the ſimple Ratio of the Moon's horizontal Parallax, and then according to the Diff. of the Cubes of the Sun's Diſtance inverſely, for giving the correct central Equation, when this 2d is connected with the firſt Part.

The MOON's LONGITUDE computed from the TABLES, to a 100 PLACES, and compared with the respective OBSERVATIONS. C.

Eclipses, and whose Observations	Years of *Christ*.	*Equal Time* of Moon's transiting the Meridian. M	D	H	M	S	Annual Argument. s	°	'	☽ à ☉. s	°	'	Moon's *Longitude* observed. s	°	'	"	*Error* of Computation. '	"
Moon Ecl.	1628	January	10	9	26	31	1	21	26	6	0	0	♌	0	27	16	+ 0	42
Sun . . .	1661	March	19	23	16	11	7	0	21	0	0	33	♈	11	4	9	+ 0	5
Sun . . .	1676	May	31	22	23	30	0	23	3	0	0	17	♊	21	26	17	— 0	4
Moon . .	1681	August	18	15	19	0	8	6	29	6	0	0	♓	6	14	33	+ 0	34
Moon . .	1682	February	11	11	13	19	1	13	36	6	0	0	♍	3	47	33	+ 0	5
Moon . .	1685	November	30	10	30	35	5	25	0	6	0	0	♊	19	39	39	+ 0	43
Flamstead.	1689	November	16	11	47	20	0	0	1	6	0	45	♊	6	12	43	+ 1	3
	1690	April	18	16	23	50	4	16	4	8	2	0	♑	11	43	52	+ 1	44
	1690	*April*	20	18	2	32	4	17	50	8	25	5	♒	6	30	55	— 0	28
Sun Ecl.	1715	April	21	20	2	40	6	21	27	11	29	8	♉	11	20	17	— 0	2
Sun Ecl.	1722	November	27	1	21	22	3	16	44	11	29	40	♐	15	53	5	+ 1	58
Dr. Halley.	1725	December	5	9	8	5	11	22	19	4	21	24	♉	15	42	12	+ 1	1
	——		8	12	19	26	11	25	11	6	4	46	♋	2	58	38	+ 0	29
	1726	January	6	12	8	23	0	21	20	5	28	25	♋	26	7	46	— 0	50
	——		13	18	0	45	0	27	51	9	1	48	♏	6	54	59	— 0	16
	——	March	6	12	10	8	2	13	58	5 ~~6~~	29	29	♍	26	42	2	— 0	15
	——		12	16	56	19	2	19	24	8	13	13	♐	16	46	53	— 1	10
	——	April	5	12	20	22	3	10	9	6	5	30	♏	2	15	10	— 0	4
	——	May	9	16	4	15	4	9	29	7	25	54	♑	26	11	14	+ 1	26
	——		13	19	3	0	4	13	0	9	12	17	♓	15	49	35	— 1	25
	——	June	7	15	33	34	5	4	7	7	18	13	♒	16	18	50	+ 1	35
	——	July	3	12	43	4	5	26	3	6	7	44	♒	0	0	32	+ 0	28
	——		10	17	44	7	6	2	10	8	28	56	♈	27	54	1	— 0	19
	——	August	12	21	20	21	7	0	26	10	19	17	♋	19	39	22	— 0	25
	——		22	5	7	25	7	8	27	2	21	50	♐	1	40	23	+ 1	18
	——	September	4	15	13	50	7	20	3	7	23	2	♉	16	21	33	— 0	59
	——	December	17	3	56	48	10	22	5	1	25	56	♓	3	20	1	— 0	15
	1727	March	23	10	17	43	1	17	53	5	1	23	♍	14	35	27	— 0	47
	——	May	22	11	3	24	3	9	29	5	18	47	♐	0	12	2	+ 1	3
	——	June	29	17	39	0	4	11	56	8	26	43	♈	14	58	28	— 0	24
	——	September	18	11	34	42	6	21	12	5	26	21	♈	2	25	41	+ 0	5
	——		26	18	10	22	6	28	27	9	2	2	♋	16	32	9	+ 0	14
	1728	March	13	11	25	5	11	29	9	5	19	51	♍	24	6	20	+ 1	13
	——		24	21	17	28	0	9	7	10	15	12	♓	0	30	42	— 1	16
	——	May	8	8	41	11	1	17	26	4	11	50	♎	10	7	18	+ 1	44
	——	June	10	12	17	1	2	15	36	6	3	19	♑	4	6	2	+ 1	17
	——	October	14	18	13	17	6	4	18	9	2	5	♌	5	11	23	+ 0	50
	1729	May	7	17	47	34	0	6	0	8	22	50	♒	21	8	49	— 1	48
	——		24	6	6	48	0	20	4	2	29	58	♍	13	47	44	— 0	57
	——	September	28	13	51	44	4	9	7	7	2	55	♉	20	11	31	+ 0	39
	——	October	2	17	11	53	4	12	46	8	18	13	♋	9	21	12	+ 1	25
	——		3	18	1	35	4	13	41	8	29	53	♋	21	46	46	+ 1	50
	——		6	20	23	20	4	16	24	10	6	33	♍	0	52	10	+ 1	5
	——	November	2	18	15	6	5	10	19	9	3	13	♌	5	11	23	+ 0	50
	1730	April	1	20	58	50	9	24	15	10	12	16	♓	4	50	54	— 0	30
	——	November	20	17	34	18	4	15	31	8	23	37	♍	3	31	30	— 0	41
	1731	January	4	6	15	8	5	25	40	3	7	38	♉	2	45	27	+ 1	11
	——		19	17	52	20	6	9	36	9	0	39	♏	11	44	5	— 0	32
	——	February	2	5	49	14	6	21	39	2	29	52	♉	24	17	15	— 0	29
	——	April	10	11	39	16	8	20	49	5	26	45	♎	28	6	40	+ 0	2
	1732	January	4	14	56	0	4	15	5	7	12	51	♍	8	45	28	+ 0	39
	——	February	29	12	13	30	6	5	0	6	2	57	♍	24	47	30	+ 0	45
	——	September	19	8	55	22	11	29	13	4	15	53	♒	23	10	18	— 0	10
	——		22	11	37	28	0	1	57	5	29	2	♈	10	8	27	— 0	22
	——		28	17	27	31	0	7	25	8	22	42	♋	9	56	59	+ 0	13

The

The MOON's LONGITUDE computed from the TABLES (continued) and compared with the respective OBSERVATIONS. C.

Eclipses. and whose Observations	Years of *Christ.*	*Equal Time* of Moon's transiting the Meridian. M	D	H	M	S	Annual Argument. s	°	′	☽ à ☉. s	°	′	Moon's *Longitude* observed. s	°	′	″	*Error* of Computation. ′	″
Dr. *Halley.*	1732	November	20	9	40	0	1	24	21	6	0	0	♊	10	3	17	— 1	12
	1733	April	11	7	28	48	6	0	35	3	20	27	♌	22	37	32	+ 0	28
	—		17	11	47	54	6	5	55	5	28	17	♏	6	58	50	+ 0	34
	—		25	18	19	41	6	13	1	9	2	18	♒	18	55	9	— 1	14
	—		26	19	8	56	6	13	54	9	15	34	♓	3	1	6	— 0	54
	—	May	13	9	0	33	6	28	4	4	17	39	♎	20	43	41	— 0	31
	—		27	20	27	53	7	10	21	10	9	30	♈	26	26	16	+ 0	11
	—	September	9	9	24	57	10	9	37	4	23	8	♒	20	28	34	— 1	20
	—		14	13	53	12	10	14	8	7	2	10	♉	5	43	15	— 0	10
	—		18	17	48	55	10	17	46	8	28	36	♋	5	33	34	+ 0	27
	—		21	20	25	14	10	20	29	10	7	42	♌	17	11	25	+ 0	44
	1734	April	12	16	33	43	4	20	53	8	5	28	♑	9	36	4	— 1	12
	—	December	22	6	11	42	0	1	12	3	5	0	♈	16	52	31	+ 0	23
	1735	January	3	17	24	15	0	12	27	8	21	41	♎	16	43	41	— 0	35
	—		22	7	37	0	0	29	10	3	25	13	♊	8	12	52	— 0	59
	—		25	10	38	20	1	1	58	5	8	8	♋	24	26	42	+ 0	42
Moon Ecl.	—	September	20	13	10	20	7	27	13	6	0	0	♈	8	19	48	+ 0	32
Moon . .	1736	March	15	12	6	43	1	5	20	6	0	0	♎	6	36	27	+ 0	21
Moon . .	—	September	8	14	52	0	6	7	7	6	0	0	♓	27	20	57	+ 0	28
Sun Ecl.	—		23	4	34	6	6	19	29	11	29	49	♎	11	28	43	+ 0	32
Sun . .	1737	February	8	2	37	53	11	2	10	0	0	5	♓	11	11	23	— 0	56
Dr. *Bradley.*	1743	September	22	12	11	36	9	3	53	6	4	44	♈	15	15	0	— 0	7
	—	October	19	9	59	38	9	27	36	5	1	56	♈	8	34	14	— 0	8
	—	November	9	3	14	33	10	16	0	1	17	25	♑	16	6	0	— 0	44
	—	December	13	6	25	48	11	16	43	3	6	48	♈	9	20	15	+ 0	17
	—		19	12	1	32	11	22	30	5	29	26	♋	8	18	51	+ 0	9
	—		26	18	21	40	11	28	52	9	6	9	♎	22	30	40	— 0	32
	1744	March	23	17	38	42	2	16	43	8	21	48	♑	6	24	1	— 0	36
	—	April	10	8	4	38	3	2	20	3	26	12	♌	27	45	41	— 0	11
	—	May	13	10	44	0	4	0	45	5	13	31	♏	17	1	57	+ 0	4
	—		23	18	47	21	4	8	48	9	9	49	♓	22	47	0	— 1	10
	—		24	19	28	40	4	10	0	9	21	33	♈	5	34	17	— 1	18
	—		26	20	57	3	4	12	13	10	16	9	♉	2	20	31	— 0	44
	—	June	2	2	55	31	4	17	31	1	9	28	♌	2	50	24	— 1	32
	—		5	5	38	23	4	20	9	3	2	8	♍	17	51	59	— 1	32
	—		9	8	41	9	4	23	40	4	13	50	♏	12	46	17	— 0	43
	—		18	16	2	51	5	1	38	7	26	26	♓	5	41	19	+ 1	2
	—	July	12	11	42	4	11	29	25	5	23	45	♑	24	52	5	— 1	17
	—		13	12	32	40	5	22	36	6	4	46	♒	7	10	8	0	0
	—	August	19	17	56	17	6	24	26	9	2	47	♊	10	42	18	— 0	34
	—	September	4	4	55	23	7	5	12	2	18	0	♐	8	32	0	+ 0	34
	—		15	15	51	15	7	17	46	8	1	33	♊	0	20	56	— 1	10
Moon Ecl.	1747	February	13	17	17	0	9	10	53	6	0	1	♍	6	17	7	+ 0	38
Sun . . .	1748	July	14	0	15	48	0	10	22	0	0	24	♌	3	9	37	+ 0	11
Moon . .	1750	June	8	8	58	30	8	18	18	5	29	58	♐	28	17	24	— 1	26

☞ Number of Observations 100; Difference of the Errors, in Seconds of a Degree, 4428″, whence the mean Difference of *Error*, ± 44″ 17‴.

But the { *Negative* / *Affirmative* } Errors { = — 37′ 15″ / = + 36 33 } = ± 73′ 48″ *Diff.*

Whence, the *Sum* is negative . . — 42″

N. B. The 100 *lunar* Places, in Pages 372 and 373, were computed before the *Acceleration Table*, P. 374, for correcting the Moon's mean Motions, and *Table*, P. 375, for correcting the VI. and VII. Equations, were made; which Places, and that in *Example*, P. 49, are computed independent of those *correcting Tables.*

Total·

Total CORRECTION of the Mean MOTION of the MOON.

According to Correction of the Moon's MEAN MOTION and ACCELERATION; for any Year of a given Century before and since CHRIST. C.

Centuries before and after *Christ.*	*Correction* of M. Motion ☽, for given Centuries, 1ˢ 7° 52′ 45″, Mot. for 1 Century.	*Acceleration,* as the Square of the Centuries. For 1620 and 1820, + 10″.	Total *Correction* of M. Mot. ☽, the Sum or Dif. of Correction, M. Mot. and Acceleration.	Total *Differences* in a Century.
	° ′ ″	° ′ ″	° ′ ″	′ ″
B.C. 1000	— 1 3 28	+ 2 3 18	+ 0 59 50	6 34
900	— 1 1 8	+ 1 54 24	+ 0 53 16	6 14
800	— 0 58 48	+ 1 45 50	+ 0 47 2	5 54
700	— 0 56 28	+ 1 37 36	+ 0 40 8	5 34
600	— 0 54 8	+ 1 29 42	+ 0 35 34	5 14
500	— 0 51 48	+ 1 22 8	+ 0 30 20	4 54
400	— 0 49 28	+ 1 14 54	+ 0 25 26	4 34
300	— 0 47 8	+ 1 8 0	+ 0 20 52	4 14
200	— 0 44 48	+ 1 1 26	+ 0 16 38	3 54
— 0	— 0 42 28	+ 0 55 12	+ 0 12 44	3 34
A.C. 100	— 0 40 8	+ 0 49 18	+ 0 9 10	3 14
100	— 0 37 48	+ 0 43 44	+ 0 5 56	2 54
200	— 0 35 28	+ 0 38 30	+ 0 3 2	2 34
300	— 0 33 8	+ 0 33 36	+ 0 0 28	2 14
400	— 0 30 48	+ 0 29 2	— 0 1 45	1 54
500	— 0 28 28	+ 0 24 48	— 0 3 40	1 34
600	— 0 26 8	+ 0 20 54	— 0 5 14	1 14
700	— 0 23 48	+ 0 17 20	— 0 6 28	0 54
800	— 0 21 28	+ 0 14 6	— 0 7 22	0 34
900	— 0 19 8	+ 0 11 12	— 0 7 56	0 14
1000	— 0 16 48	+ 0 8 38	— 0 8 10	0 6
1100	— 0 14 28	+ 0 6 24	— 0 8 4	0 26
1200	— 0 12 8	+ 0 4 30	— 0 7 38	0 46
1300	— 0 9 48	+ 0 2 56	— 0 6 52	1 6
1400	— 0 7 28	+ 0 1 42	— 0 5 46	1 26
1500	— 0 5 8	+ 0 0 48	— 0 4 20	1 56
1600	— 0 2 48	+ 0 0 14	— 0 2 34	2 6
1700	— 0 0 28	+ 0 0 0	— 0 0 28	0 28
1720	0 0 0	0 0 0	0 0 0	0 43
1750	+ 0 0 42	+ 0 0 1	+ 0 0 43	1 15
1800	+ 0 1 52	+ 0 0 6	+ 0 1 58	2 46
1900	+ 0 4 12	+ 0 0 32	+ 0 4 44	3 6
2000	+ 0 6 32	+ 0 1 18	+ 0 7 50	

EXAMPLES of the CONSTRUCTION of this TABLE.

EXAMPLE I.

Radical Year 1720
B. C. + 1000

Centuries 27,20 × 2′ 20″ = 1° 3′ 28″
10″ × 27,20 □ = 739,84 × 10″ =
Acceleration = + 2° 3′ 18″
Correction of M. Mot. — 1 3 28

Total Cor. M. Mot. + 0 59 50

EXAMPLE II.

Radical Year 1720
A. C. — 900

Centuries 8,20 × 2′ 20″ = 19′ 8″.
10″ × 8,20 □ = 67,24 × 10″ =
Acceleration = + 0° 11′ 12″
Correction of M. Mot. — 19 8

Total Cor. M. Mot — 7 56

EXAMPLE III.

Radical Year — 1720
A. C. 2000

Centuries 2,80 × 2′ 20″ = 6′ 32″.
10″ × 2,80 □ = 7,84 × 10″ =
Acceleration = + 1′ 18″
Correction of M. Mot + 6 32

Total Cor. M. Mot. + 7 50

☞ The *Correction* of mean Motion of the Moon is according to 2′ 20″ for each Century, from the *radical* Year: — *before*, and + *after* 1720. And the Acceleration is according to 10″ for each square Century, from the *radical* Year: + *before* and *after* 1720. Whence, by connecting those Quantities, the total Correction of mean Motion, and total Difference in each Century, are determined, as above.

N. B. THE *Acceleration* of the *Moon's Apogee* is the same as that of the *Moon*; but with a *contrary* Sign, or —, from the *radical* Year; and consequently, the *Acceleration* of the Moon's *Anomaly* is double the Acceleration of the *Moon*; with the same Sign, or +, from the *radical* Year, 1720. The Acceleration of the Moon's Node, from the same *radical* Year 1720, is the *Half* + $\frac{1}{5}$ of that Half, of the *Moon's Acceleration,* with the same Sign, or +, from the *radical* Year.

Acceleration ☽.	Acceleration ☽'s An.	Acceleration ☽'s Ap.	Acceleration ☽'s ☊.
THUS, + A.	+ 2A.	— A.	$+ \frac{1}{2} A + \frac{\frac{1}{2} A}{5}$.

THE above *Acceleration-Table* is added to be examined by future Observations; that it may be determined whether the Moon's *mean Mo*[illegible] *quicker* in this Age than our Tables of mean Motion represent: as many Observations of *lunar Eclipses,* and other Observations, without the *Syzygies,* seem to prove an *Acceleration,* different to what is *remarked in P.* 55.

A TABLE

A TABLE for correcting the Sum of the VIth and VIIth EQUATIONS of the MOON, at the Beginning of the Tables. C.

Argument. ☽ à ☉.	Dec. ×rs.	Lo. Log.	*Argument.* ☽ à ☉.
0s 6s 0°	,59	2291	0° 12s 6s
5	,59	2291	25
10	,60	2218	20
15	,62	2076	15
20	,64	1938	10
25	,66	1805	5
1 7 0	,69	1612	0 11 5
5	,72	1427	25
10	,75	1249	20
15	,79	1024	15
20	,83	0809	10
25	,86	0655	5
2 8 0	,89	0506	0 10 4
5	,92	0362	25
10	,95	0223	20
15	,97	0132	15
20	,99	0044	10
25	1,00	0000	5
3 9 0	1,00	0000	0 9 3

EXAMPLES of the USE of the *Decimal Multipliers* and *Logistical Logarithms.*

EXAMPLE I.

	Lo. Log.
+ 4′ 6″	1.1654
☽ à ☉, 1s	0.1612
2′ 50″	1.3266

VI. *Equation,* + 2′ 25″
VII. *Equation,* + 1 41
Sum, + 4 6
In Seconds, + 246″
☽ à ☉ . . 1s . . ,69 ×r.
2214
1476
169,74 = + 2′ 50″ Equation.

EXAMPLE II.

	Lo. Log.
− 1′ 10″	1.7112
☽ à ☉, 1s 15°	0.1024
− 0′ 55″	1.8136

VI. *Equation,* − 2′ 0″
VII. *Equation,* + 0 50
Sum, − 1 10
In Seconds, − 70″
☽ à ☉ . . 1s 15° . . ,79 ×r.
630
490
55,30 = − 55″ Equation.

RULE. Multiply the *Sum* of the VI. and VII. Equations, connected with its proper Sign, by the decimal ×r, correspondent to ☽ à ☉, for the *Product* of the *required Equation.* Or add the Lo. Log. correspondent to ☽ à ☉, to the Lo. Log. of the Sum of the VI. and VII. Equations, for Lo. Log. of the *required Equation,* to which prefix the Sign of the *Sum* of Equations.

A COMPARISON of the *Number, Arguments,* and GREATEST EQUATIONS of the MOON.

According to our *Royal Astronomer.*				According to *Mayer.*				According to Sir *I. Newton.*
N.	*Arguments.*	Sig.&Deg	Greatest Equations ☽.	No.	*Argts.* correspong.	Sig.&Deg.	Greatest Eq. ☽.	Arguments and Greatest Eq.
I. *a*	☉'s M. Anom. denotes *Annual.*	3s 0° 9 0	☽ − 11′ 25″ Ap. + 26′ = 19′ 38″ + 6′ 22″ ☊ . . . − 9′ 21″	I. *a*	☉'s M. Anom.	3s 2° 8 29	☽ − 11′ 20″	1 *Arg.* ☉ M.An. − 11° 50′ Apogee ☽ . . + 19 43 ☊ . . − 9 24
II. *s*	☉ à ☽'s Ap. denotes *Semiannual.*	1 15 10 15	∓ . . 5′ 59″ = 3′ 45″ + 2′ 14″	X. *s*	☽ à ☉ − M. An ☽ *reversed* Arg.	1 15 10 15	± . . 3′ 45″	2. Arg. ☉ à ☽ Ap. 3′ 34″ ☉ Ap. ☉ in *Octants* 3 56 ☉ Per.
III. *s*	☉ à ☊	1 15 10 15	∓ . . 0′ 47″	IX. *s*	☊ à ☉ *reversed* Arg.	1 15 10 15	± . . 0′ 47″	3. *Arg.* . . . ☉ à ☊ Oct- 1s 15° − . 0′ 47″ ☽ ants 10 15 + − to 3s + to 6s − to 9s + to 12s
IV. *s*	Mean *Evection* + 2. ☉ à ☊.	3 0 9 0	± . . 1′ 0″	VII. *s*	2. ☽ à ☊ − ☽ An.	3 0 9 0	± . . 0′ 58″	. . . .
V. *s*	Mean *Evection* + 2. ☽ M. An.	3 0 9 0	± . . 1′ 25″	VI. *s*	2. ☽ à ☉ + ☽ An.	3 0 9 0	± . . 1′ 30″	. . . .
VI. *s*	Mean *Evection* + ☉'s M. An.	3 0 9 0	± . . 2′ 25″	IV. *s*	2. ☽ à ☉ + ☉ An. − ☽ An.	3 0 9 0	± . . 1′ 48″	5. *Arg.* ☽ à ☉ + ☽ Ap. à ☉ Ap 3s 9s ± 2′ 25″ + to 6s − to 12s *Arg.*
VII. *s*	Mean *Evection.* − ☉'s M. An.	3 0 9 0	± . . 3′ 41″	V. *s*	2. ☽ à ☉ − ☉ An. − ☽ An.	3 0 9 0	± . . 1′ 12″	. . . .
VIII *a*	☽'s corrected An.	3 4 8 26	∓ 6° 18′ 38″	XI. *a*	☽ corrected An.	3 4 8 26	± 6° 18′ 44″	4. *Arg.* ☽'s An. fr. 1st and 2d Eq. Ap. ☽. *Central Eq.* accordg to *Eccentricity* ☽ Orb. includg our 8 and 9; or *Mayer's* 11 and 12. − to 6s + to 12s *Arg.*
IX. *a*	Tr. *Evec.* or M. *Evec.* ∓ ½ Eq. ☽'s Cent.	3 1 8 29	∓ 1° 20′ 26″	XII. *a*	2. ☽ à ☉ cor. − ☽ An.	3 1 8 29	± 1° 20′ 43″	
X. *s*	☽ eq. à ☉ tr.	1 14 4 14	+ . 36′ 50″ ☽ falc. − . 39 22, gibbous.	XIII *s*	☽ eq. à ☉ true.	1 14 4 15	+ 39′ 3″ ☽ fal. − 41 41, gibb.	6. Arg. ☽ à ☉ In *Octants* Fr. 33′ 14″ To 37 11 7. Doubtful to *Newton.*

No.	For the MOON's Latitude.							
I.	☽ in Orb à ☊.	3s 0° 9 0	+ 5° 8′ 28″	I.	☽ in Orb à ☊.	3s 0° 9 0	+ 5° 9′ 8″	☞ M. *Evec.* − 2. ☽ + 2. ☉ + ☽ An. + any Com. *Arg.* = that Arg. *transform'd* to mean *Evection.*
II.	☽ à ☉ − ☽ à ☊	3 0 9 0	± . . 8 52	II.	2. ☽ à ☉ − ☽ à ☊.	3 0 9 0	± . . 8 50	

No.	For the Moon's PARALLAX.							
I.	M. An. ☽ equated.	6s 0	+ . 60′ 25″	I.	☽ cor. An.	6 0	+ . 60′ 26″	*Because* 2. ☽ − 2. ☉ − ☽ An. = Mean Evec. = ☽ M. An. − 2. ☉ à ☽ Apogee.
II.	Mean *Evection*	0 0	− . . . 42″	II.	2. ☽ à ☉ − ☽ An	0 0	 38	
III.	☽ eq. à ☉	3 0	− . . 1 0	III.	☽ eq. à ☉	6 0	 28	

Mayer's II. III. and VIII. Equations have these Arguments and Greatest Equations.

Arguments.	Sig. Deg.	Gr. Equat.	Arguments *transformed.*
II. 2. ☽ à ☉ + ☉ M. An.	3s 0° 9 0	∓ 0′ 54″	Or Arg. Mean *Evection* + Moon's M. Anomaly + Sun's M. Anomaly.
III. 2. ☽ à ☉ − ☉ M. An.	3 0 9 0	∓ 1 2	Or Arg. Mean *Evection* + Moon's M. Anomaly − Sun's M. Anomaly.
IV. ☽ M. An. − ☉ M. An.	3 0 0 0	± 0 40	Or Arg. Mean *Evection* + Sun's M. Pl. + Sun's Ap. − 2. Moon's Ap.

Of

Of DETERMINING *the* MAXIMA, *and* CONSTRUCTION *of the* LUNAR EQUATIONS *at the Beginning of this* WORK.

I. FOR the greatest ANNUAL EQUATION of the MOON.

Put Q = S. Sun's Equat. at greatest; s = the Ds of ☉'s Period; m = Moon's Period to ✶♉; n = ☽'s *synodic* Period to Sun; Then,

$\frac{3mm}{2,1061\,sn} \times Q$ = Sine greatest annual Eq. ☽ = 11′ 25″.

	Logs.		Logs.
3	0.4771212	2,1061 . .	0.3234790
m^2=27d,3216 squared	2.8730122	s = 365d,2565	2.5625979
Q = S. 1° 55′ 50″	8.5274775	n = 29d,53	1.4702634
Sum,	11.8776109	Sum,	4.3563403
	— 4.3563403		

Gr. an. Eq. ☽ 11′25″ S. 7.5212706 Dif.

For gr. Equation ☽'*s Apogee, or* ☊.

Put p = *m. periodic* Time ☽'s Ap. or ☊, and q = Time of *synodic* Revolution of the Sun to Ap. or ☊. Then

$\frac{3q}{2,2551\,p} \times$ Q = S. *gr. Eq. Ap.* And $\frac{3,1669\,q}{2p} \times$ Q = S. *gr. Eq.* ☊.

3	0.4771212	2,2551 . . .	0.3531658
q = 411d,7863 . .	2.6146718	p = 3231d,357	3.5093850
Q = S. 1° 55′ 50″ . .	8.5274775	Sum,	3.8625508
Sum,	11.6192705		
	— 3.8625508		

Gr. Eq. Ap. 19′ 38″ *Dif.* S. 7.7567197
+ 6 22 Correction of Evection *added.*

26 0

Again, 3.1669	0.5006344	2	0.3010300
q = 346d,6197	2.5398533	p = 6798d,203	3.8323941
Q = S. 1° 55′ 50″	8.5274775	*Sum,*	4.1334241
Sum,	11.5679652		
	— 4.1334241		

G. Eq. ☊ 9′ 21″ *Dif.* S. 7.4345411

For present Equations ☽, *Apogee, and* ☊.

As $\left\{\begin{array}{l}\text{gr. Eq. ☉}\\ 1^\circ\ 55'\ 50''\end{array}\right\}$ to $\left\{\begin{array}{l}\text{gr. an. Eq. ☽}\\ \text{gr. Eq. ☽ Ap.}\\ \text{gr. Eq. ☽'s ☊}\end{array}\right\}$ so $\left\{\begin{array}{l}\text{Pres.}\\ \text{Eq.}\\ \text{☉}\end{array}\right\}$ to $\left\{\begin{array}{l}\text{Pres. Eq. ☽.}\\ \text{Pre. Eq. Ap.}\\ \text{Pres. Eq. ☊.}\end{array}\right\}$

	Gr. Eq. ☽	Ap.	☊.
Sir *Isaac Newton* determines	11′49″	19′43″	9′24″
Mr. *Machin* from his Principles	12 5	21 57	8 56

When Sir *I. Newton* had found the *ann. Eq.* ☽, he proportions,
As m. diur. Mot. ☉ 59′ 18″ 19‴ to $\left|\begin{array}{l}\text{M. diur. Mot. Ap. } 6'\ 44''\ 4'''\\ \text{M. diur. Mot. ☊ } 3\ 10\ 38\end{array}\right|$ so $\left|\begin{array}{l}\text{☉Eq. } 1^\circ 56'\ 20''\\ \tfrac{1}{2}\ .\ .\ 58\ 10\end{array}\right.$
to $\left|\begin{array}{l}\text{gr. Eq. Ap. } 19'\ 43''\\ \text{gr. Eq. ☊ } 9\ 24\end{array}\right.$ $\left.\begin{array}{l}\textit{respectively,}\\ \text{as above.}\end{array}\right\}$ so* 2° 53′45″ $\left|\begin{array}{l}19'38''\\ 9\ 21\end{array}\right.$ $\left\{\begin{array}{l}\overline{}\\ 2^\circ\ 54'\ 30''\end{array}\right.$

The Eq. of $\left\{\begin{array}{l}\text{☽}\\ \text{Ap.}\\ \text{☊}\end{array}\right\}$ $\left\{\begin{array}{l}\textit{adds}\\ \textit{sub.}\\ \textit{adds}\end{array}\right\}$ in 1st 6 Signs. ☉'s M. An. but $\left\{\begin{array}{l}\textit{sub.}\\ \textit{adds}\\ \textit{sub.}\end{array}\right\}$ in the last 6 Signs. Sun's mean Anomaly being the Argument.

II. FOR the greatest first SEMIANNUAL EQUATION ☽.

As *synodic* Time ☉ à ☽'s Ap. 411d,786 squared, co.	4.7706568
To *synodic* Time ☽ à ☉ . . . 29d,53 squared . . .	2.9405268
So S. gr. 2d Equat. Moon's Ap. . . 12° 18′ . . .	9.3284416
To S. *gr. first Semi-an.* Equat. req. 3′ 46″ in Octants ☉	7.0396252

Or, in the same *Ratio,*

	Logarithms.
As Sq. M. diur. Mot. ☽ à ☉, 12° 11′ 27″ = 43887″ sqd. co.	0.7153282
To Sq. M. diur. Mot. ☉ à ☽'s Ap. 52′27″ = 3147″ sq.	6.9457934
So Sine gr. 2d Equat. Ap. 12° 18′	9.3284416
To S. 3′ 46″ as before, in Octants	7.0395632

Now, in Octants this Equation is increased and diminished in the reciprocal *triplicate Ratio* of the Sun's Distance from the Earth; and is 3′ 34″ when least, and 3′ 56″ when greatest. — But when the Moon's Apogee is *out of the Octants,*

As *Rad.* : *to Arg. or* 2. ☉ à ☽'s *Ap.* (or, according to *Newton,* *twice* Moon's Apogee from nearest Sizigy) :: 3′ 46″, or other greatest Equation in *Octants* : present Equation, *required.*

This Equation adds to mean Motion in the Passage of the Moon's Apogee, from the Quadrature of the Sun to the Syzigy; but subtracts in its Passage from the Syzygy to the Quadrature.

III. FOR the *greatest* second SEMIANNUAL EQUATION.

As Radius	10.0000000
To Sine of mean Inclination ☽'s Orb 5° 8′ 28″	8.9525514
So S. Half Dif. between gr. and least Inclin. 8′ 52″	7.4114[illegible]
To S. 47″ 40‴, greatest Equation, required . . .	6.3[illegible]

[in Octants of ☉ à ☊; in [illegible] in Ap. [illegible]

Being reciprocally, as Cube of the Sun's Distance from the Ea[illegible]

In other Positions,

As *Rad.* : *S. Arg.* 2. ☉ à ☊ (or, according to *Newton,* *twice* ☊, from nearest Syzygy) :: *S. greatest Equation* 47″, [illegible] *quation in Octants,* : *S. present Equation,* required, [illegible] of the ☉ à ☊, which is the *Argument of this Equation.*

IV. FOR the greatest of THIS EQUATION.

As Radius	10.0000000
To Cube Cos. mean Inclination of ☽'s Orb, 5° 8′28″	9.9947[illegible]
So Sine of Evection-Equation . . . . 1° 20′ 40″	8.3703[illegible]
To Sine of . . . . . . — 1° 19′ 42″	8.3651271

Dif. Greatest Equation, *required,* . . 58″ B. *Tabs.* 1′

As *Rad.* : *S. Arg. mean Evection* + 2. ☉ à ☊ :: 58″ *or* 1′ : *present Equation.*

V. FOR the greatest of THIS EQUATION.

As *Sum* of Forces ~~355,450~~ 6,50 . . . . . co.	7.4467847
To 3, Dif. solar Force ☽ Per. and Apog. ,1718 . . .	9.2350232
So Radius	10.0000000
To S. 1′ 39″. greatest Equation, required . .	6.6818070

As *Rad.* : *S. Arg. Evection* + 2 ☽ *M. Anom.* :: 1′ 39″ : *present Equation.*

*VI. and VII. FOR the Sum of these GREATEST EQUATIONS.

As Semi-Transv. Earth's Orbit 100000 . . . co.	5.0000000
To 3 Times Eccentricity 1685 = 5055	3.7037212
So S. Evection 1° 20′ 40″	8.3703804
To S. Sum Equations 4′ 5″ required	7.0741016

1° 55′ 50″ Sun's Equation.
57 55 Half.

So* 2 53 45 Sum.

* As 100000 ☽'s mean Dist. fr. ⊖ : to 2 DF (see P. 369, *l.* 12. *fr. bot.*) = 119,26 :: so Rad. : to Tang. 4′ 6″, = ∠ *subtended* by 2 DF, seen from the ☽, at a mean Dist. and Perp. thereto; or seen at ☽, in a parallel Position to DF, from the *upper Focus* of ☽'s Orbit. *See Fig.* III, *foregoing* *and Fig.* IV, *further on.*

VI.

Of DETERMINING *the* MAXIMA, *and* CONSTRUCTION *of the* LUNAR EQUATIONS *at the Beginning of this* WORK.

VI. FOR the greatest of THIS EQUATION.

		Logarithms.
As Sem. Tran. Earth's Orbit . .	100000 co.	5.0000000
To twice Eccen. 1685 = 3370		3.5276299
And 59 to 52		9.9451513
So S. Evection . . . 1° 20′ 40″ : .		8.3703804
To S. this gr. Equation . . 2′ 24″ required . .		6.8431616
Sum Equations . . 4 5 .		

Dif. 1 41 greatest VII. Equation.

VI. Rad. : S. Arg. Evec. + Sun's M. An. :: 2′ 24″ : present Equation.

VII. Rad. : S. Arg. Evec. — Sun's M. An. :: 1′ 41″ : present Equation.

N. B. *The Tables shew, by the Arguments, when the Equations add or subtract.*

VIII. GREATEST EQUATION, 6° 18′ 38″, and Construction, is seen in P. 48.

IX. GREATEST EQUATION, 1° 20′ 40″, and *Construction*, are seen P. 373. See also P. 362.

X. First and principal GREATEST VARIATION-EQUATION deduced, P. 361 and 362.

N. B. The *greatest* second *Variation-Equation* is *to Rad.* : *as* 342 *to* 344, *nearly*. 342 to 344 is as the least and greatest Distance of the Moon from the Sun in Conjunction and Opposition. — Hence the greatest second Variation = 2′.

And *as Rad.* : *S. Arg.* ☽ *à* ☉ :: 2′ : *present second Variation-Equation.*

The present principal and also second Variation form the *Compound Variation*-Equation; connected together with their proper Signs.

The Tables in general shew when the Equations are to be added or subtracted.

COMPOUND EQUATIONS explained.

I. Compound annual Equations of the Moon's Apogee adds 6′ 22″ to the greatest Quantity for correcting the *Evection*.

II. or *1st Semi-annual.* — The EVECTION, at a Mean, at each Apsis, is ± 4′ 28″ ½; the *Half* 2′ 14″. The mean *Semi-annual*, at greatest, being 3′ 45″ + 2′ 14″ = 5′ 59″, as by Tables. — But the *synodic* Time of the Sun's Motion from the Moon's Apogee in the lower Semi-circle of her Orb, being less than in the higher Semi-circle, *this Equation* is diminished also. Hence arises another Equation, which, like the second *Variation*, is greatest in Quadratures of the Sun with the *Apsides*, and amounts to about 30″. It subtracts in the first *Semi-Circle*, and adds to the Moon's mean Motion in the last Semi-Circle.

The Mean of the *Dif. Maxima*, in Octants, thence arising, will be 5′ 38″, *compound Equation*. The *Construction*, As *Rad.* : *S.* 2 ☉ *à* ☽'s *Ap.* :: 5′ 38″ : *present Equation.* Again, As *Rad.* : *S.* ☉ *à* ☽'s *Ap.* :: 30″ *to another Equation.*

X. The *mean Variation* being 35′ 10″ + 2′ 14″, and Correction of mean Anomaly according to variable Eccentricity = 1′ 6″, added, make 38′ 30″, *compounded Equation.* But this *Excess* of Reduction, between the greatest and least, being 24″, and always *Subtraction of Variation*, the mean tabular Variation is 38′ 6″ ± 9″, further Correction of *Evection*, according to the Moon's Anomaly, as the Sun is in the lower, or higher *Apsis*, gives 38′ 15″ in the 1st and 4th *Quadrant*; and 37′ 57″, in 2d and 3d Quadrant.

The Construction of these Equations is,

Const. Log. 9.9903353 } 1.4 Quad. / 9.9904111 } 2.3 Quad. + Log. Tan. 45° = Log. Tan. 4th Proportional, which taken from 45° leaves 38′ 15″ / 37 57 } *Arg.* Moon à Quadrature of the Sun.

Again, As Rad. : S. ☽ à ☉ :: 2′ : to present second Equation, as before.

The Equation in the *Octants* for correcting the *Variation* according to the Moon's Anomaly, is as before 1′ 39″. But, by Observation, in the *Quadrature* and Syzygies, amounts to 1′ 10″ only; somewhat correspondent to the *Excess* of *Newton*'s second *Variation.* In order to accommodate the *Tables* to this Correction, the *Evection* is diminished 15″, and this Equation 14″. In the *Quadratures* and *Syzygies*, the Sum of this Diminution is 29″, and reduces this Equation to 1′ 10″. In the *Octants*, the Diminution is addititious to this Equation, and raises it again to its Maximum 1′ 39″.

The *Compound-Variation* is compounded of the principal, and second Variation, and also the Half of the Correction of Evection.

CONSTRUCTION of the REDUCTION-EQUATION.

As Rad. : to Cosine of the mean Inclination of the Moon's Orb :: Tangent of 45° : to a Tangent of an Angle, which, subducted from 45° leaves the greatest mean Reduction, required.

As *Radius*	10.0000000
To Cosine of mean *Inclination* of Moon's Orb. 5° 8′ 28″	9.9982493
So Tangent 45°	10.0000000
To Tang. 44 53 4	9.9982493

Diff. 6′ 56″ *Reduction*, required.

As Rad. : S. 6′ 56″ :: S. doub. Arg. : S. present mean Reduc. Equat.

For MOON's Mean LATITUDE.

Const. As Rad. : S. 5° 8′ 28″ :: S. ☽ à ☊ : S. present Lat. ☽.

For EQUATION of MOON's *mean* to her *true* LATITUDE.

Const. As Rad. : S. 8′ 52″ :: S. Arg. : S. present Equation.

☞ *The mean horizontal Parallax is determined according to the Arg.* ☽'s *M. Anom. or equated by 10 first Equations* ☽, *and compounded with some few Seconds; then reduced to the true horizontal Parallax by* Tab. *whose Argument is mean Evection* (like the mean central and Evection Equations) *and farther corrected by* Tab. *whose Argument is* ☽'s *true Place from* ☉. See P. 53.

FOR COMPARISON of COMPUTATION, Our *Astronomical Tables* are readily reduced to the *Astronomia Arcana*, or GREENWICH TABLES, of the Mean PLACES of the SUN and MOON, by the following EQUATIONS.

EQUATION of the SUN's Mean Places.

M. Pl. ☉.	M. An. ☉.	Ap. ☉.	Use the same Signs for Time back as forward.
+ 0′ 17″	+ 1′ 19″	— 1′ 2″	

EQUATION ☉'s M. Motion for 100 Years forward from 1700.

Eq. M. Mo. ☉.	Eq. Mo. An. ☉.	Eq. Mo. ☉ Ap.	Use contrary Signs for Time back.
0′ 0″	— 5′ 50″	+ 5′ 50″	

N. B. The same *Signs* are used for Time back, as for Time forward, in mean Places of ☉ and ☽.

But *contrary* Signs for Time back to those for Time forward in Motion ☉ and ☽ equated. — Cut off 2 Figures to Right, of Seconds for 100 Years for the Seconds for 1 Year and multiply by the No. of Years from 1700 for the whole Equation, in Seconds, with its proper Sign.

EQUATION of the MOON's Mean Places.

M. Pl. ☽.	M. Pl. An. ☽.	M. Pl. Ap. ☽.	M. Pl. ☊.
— 0′ 49″	+ 0′ 54″	— 1′ 43″	+ 1′ 50″

EQUATION ☽'s Motion for 100 Years forward from 1700.

M. Mot. ☽.	M. Mo. ☽ An.	M. Mo. ☽ Ap.	M. Mo. ☊.
+ 3′ 5″	0′ 0″	+ 3′ 5″	+ 3′ 5″

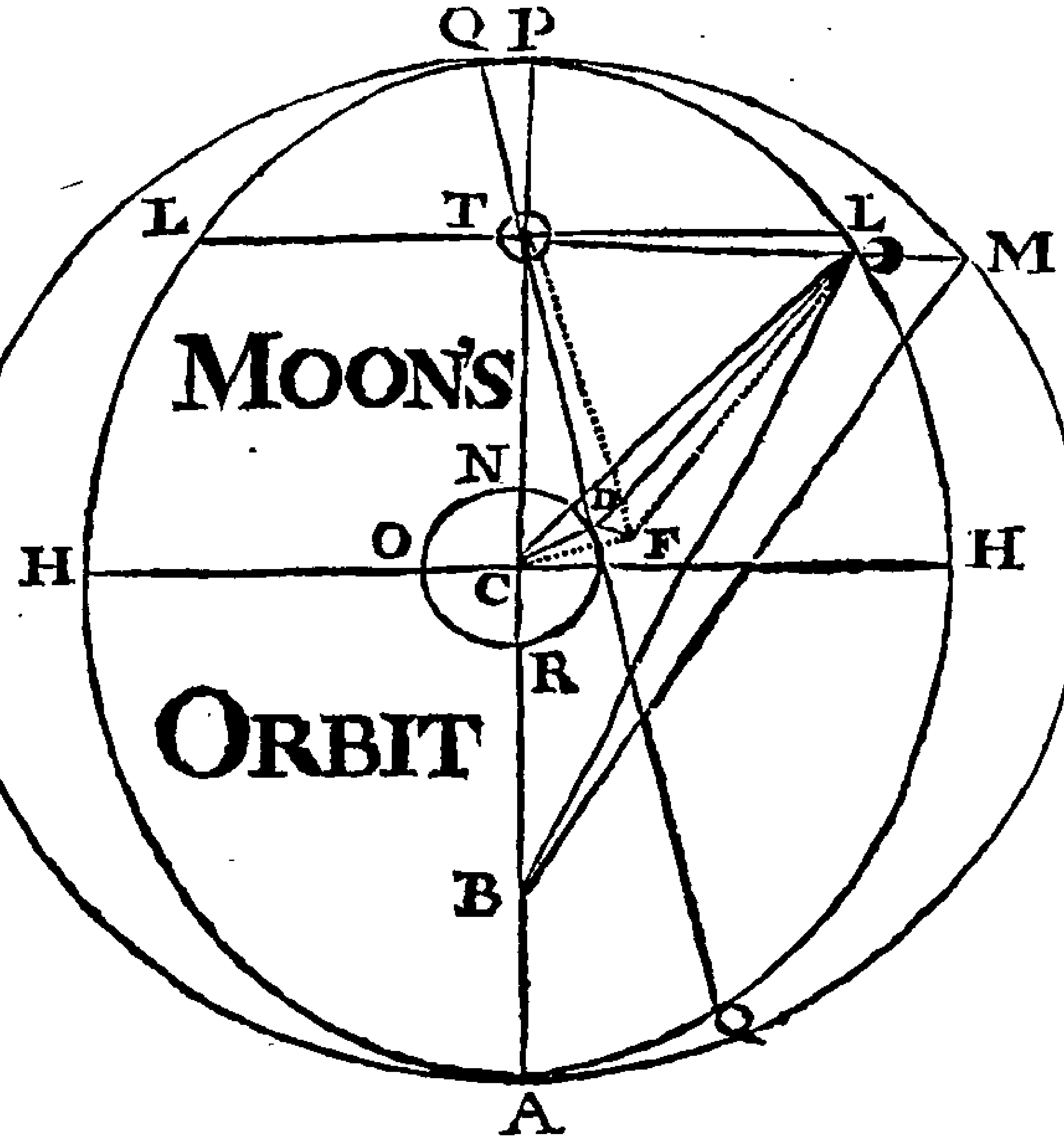
Acceleration of ☽'s Mot. for 100 Years forward or back.

+ 12″	+ 24″	— 12″	+ 8″

The Quantities of Acceleration are as the Square of Centuries or Parts of Centuries from 1750.

EXPLANATION of NEWTON's LUNAR THEORY. See Fig. IV.

FIG. IV.



AP, The *Apsides* of the Moon's M. Orbit, or *transverse Diameter* = 2000000 *Parts*, answerable to the *mean* Eccentricity = 55050 Parts = TC, or CB. T represents the Earth, in the *lower Focus* of the Moon's mean elliptic Orbit, PLHAHLP, round which the Moon's true Motion is performed. B represents the *upper Focus* of the same Orbit, round which the equal Motion of the Moon is *nearly* performed. HH, the *conjugate Diameter*; LL, the *Latus rectum*; RDNOR, the *Epicycle* of *Halley*, (whose Center is at C) in which the Center of the *Moon's Orbit* is supposed to revolve to the *Left*.

		Parts.
Therefore,	TN = least Eccentricity Moon's Orb =	43319
	TR = greatest Eccentricity . . =	66782.
	TC being = mean Eccentricity . . =	55050
Hence,	NC (= CD) = CR = TR — TC =	11732
	DF = ...	596

NOW, the Point D is moved to the Left in *Halley's Epicycle*, so as the Angle RCD may be always equal to twice Sun à ☽'s Apogee 1 equated; and CTD = ATQ, second Equation of the Moon's Apogee.

But *Newton*, for further Improvement of the *lunar Theory*, translates D to F, so that ∠ CDF = Complement of the Sun's true Anomaly to 360°, and DF to DC, as twice the Eccentricity of the Earth's Orbit to the Sun's mean Distance from the Earth, and the Sun's mean diurnal Motion from the Moon's Apogee to the Sun's mean diurnal Motion from its own Apogee, *conjunctly*, *viz.* as 33⅞ to 1000, and 52′ 27″ 16‴ to 59′ 8″ 10‴, *conjunctly*, or as 3 to 100, nearly; whereby DF = 352 *Parts* of Eccentricity, according to *Newton*. But, if CD, the *Epicycle's* Radius, be considered to DF as 10000 to 508, (for a farther Correction of the *Theory*) then, by Proportion, DF = 596,5 Parts of Eccentricity. And this DF, at the Distance of the Center of the Moon's Orb TC, subtends the Angle at the Earth, which the *Translation* of the Center of her Orbit from D to F generates in its Motion.

The *Double* of which *Line* DF, in a *parallel Position*, at the Distance of the *upper Focus*, B, of the Moon's Orbit from the Earth, seen at double Dist. of the lower *Focus*, *subtends*, at the Earth, the same Angle as DF did before, seen at the lower *Focus*, which that *Translation* from D to F generates in the Motion about this *upper Focus*. But, at the Distance of the Moon from the Earth, 2DF at the *upper Focus*, in a parallel Position to the *first Line* DF, subtends an Angle at the Moon, which the said *Translation* generates in the Moon's Motion. This Angle is called *2d Equation of the Moon's Center*, which, at a mean Distance of the Moon from the Earth, is nearly as the Sine of the Angle comprehended by *Lines* drawn from F and D to the Moon; and amounts to 2′ 25″ when *greatest*, according to *Newton*; 2DF being then at right ∠s with the Moon's mean Distance. But DF being taken = 596,5 instead of *Newton's* 352, the greatest Equation will then amount to 4′ 6″, according to *our Tables*. And the *Argument* for finding this Equation at all Times, (according to *Newton*) is by adding the Distance of the ☽ à Sun to the Moon's Apogee from the Sun's Apogee.

Then, *As Rad.* : *S. Argument thus found* :: *2′ 25″* : *present second Equation of the Moon's Center.* To be added when the Argument is *less* than a Semi-Circle, and subtracted when greater. And *thus*, by *Newton's* placing the Center of the Moon's Orb at F, to revolve round *Halley's* moving Point at D, it is made to describe a *certain curve Line*, of *variable* Radius FC, about the Center C, with a Velocity almost *reciprocally* as the Cube of the Sun's Distance from the Earth; according to the Laws of Nature, observed.

TB ☽, Angle at *upper Focus*.
AB ☽, the *mean Anomaly* of the Moon.
BC ☽, the *eccentric Anomaly* of the Moon.
BT ☽, the *true Anomaly* of the Moon.
RCD = twice Sun à ☽'s Ap. = 2, An. Argument.
TD or TF = present *Eccentricity* of the Moon's Orb.
CTD or CTF = second Equation of the Moon's Apogee.
QQ, the present *Position* of the *Apsides* or Apogee.
C☽D or C☽F, the Semi-Angle of *Evection*, at greatest (when CD☽ or CF☽ = 90°) = 40′ 20″ *fere*. ☽CD or ☽CF Argument of Evection.
☞ MB☽, Angle of Correction of the Moon's mean *Anomaly*, and ∠ABM, the Moon's corrected mean Anomaly, according to *Bullialdus*.

S. C.

DIFFERENT OBLIQUITIES of the ECLIPTIC as *observed* in different AGES of the WORLD, by *eminent* ASTRONOMERS.

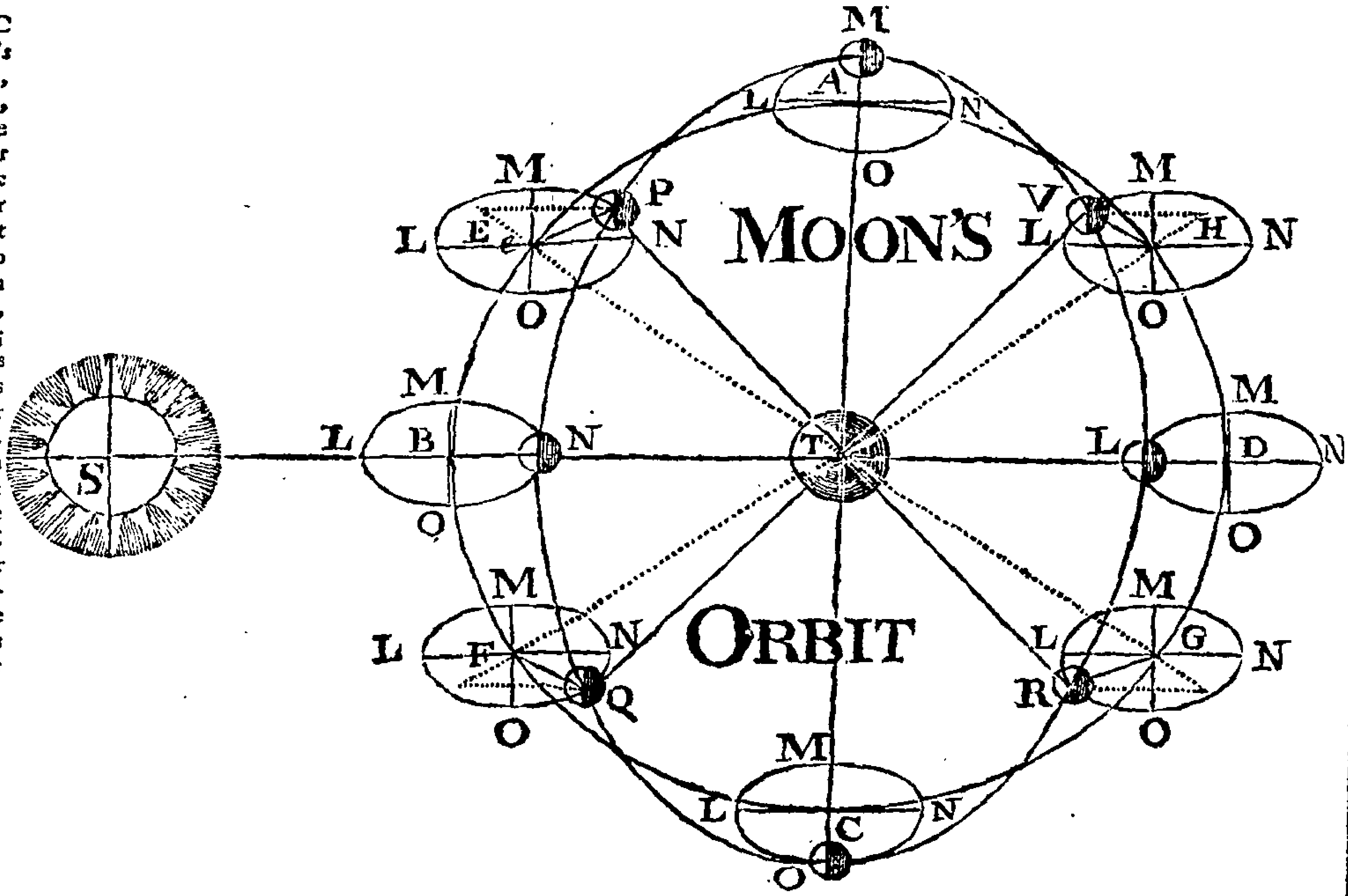
Yrs bef. Chr.	Astronomers.	Obliquity. ° ′ ″	Yrs since Christ.	Astronomers.	Obliquity. ° ′ ″	Yrs sin. Ch.	Astronomers.	Obliquity. ° ′ ″
280	*Aristarchus* .	23 51 0	880	*Mahumed Eben Gaber*	23 35 0	1490	*Dominicus Maria Navaras Ferrariensis* . . .	23 29 0
270	*Eratosthenes* .	23 51 0	911	*Ababet Eben Corra* . .	23 33 30	1514	*Vernerus*	23 28 0
140	*Hipparchus* .	23 51 0	992	*Abu Mahumed Al Cogandi* . .	23 22 21	1572	*Tycho Brahe*	23 31 0
Since Chr.			1269	*Cojah Nasirodni* . .	23 30 0	1670	*Hevelius*	23 30 20
140	*Ptolemy* . .	23 51 20	1363	*Eben Shatir* . . .	23 31 0	1760	*P. Mengoli*	23 28 24
825	*Benimula* . .	23 35 0	1437	*Uleg Fieg*	23 30 17	1673	Mr. *Flamstead*	23 29 0
827	*Almamon* . .	23 35 0	1460	*Regiomantanus* . .	23 29 0	1700	Dr. *Halley*	23 29 0
828	*Iabia Eben Abumansar*	23 35 0				1750	Dr. *Bradley*	23 28 30
							Variable also according to Pl. ☊ ☽.	

N. B. The principal *Difference* of the above Observations has partly arisen from the Imperfection of the Instruments with which they were taken, the different Skillfulness of Observers, and their imperfect Knowledge of *Parallaxes* and *Refractions*. See *Philosoph. Transactions*, No. 163. And *Marcus Manilius*.

EXPLANATION

EXPLANATION of MACHIN's LUNAR THEORY. See Fig. V.

FIG. V.



THE CIRCLE ABCD represents the *Moon's Orbit* about the Earth, placed in the Center T, at a mean Distance, the Moon having no other Gravity than to the Earth. The Diameter ATC divides the Part of the Moon's Orb ABC towards the Sun from that Part ADC, opposite to the Sun; the Diameter BTD is the Line of the Moon's Conjunction with or Opposition to the Sun. The Fig. LMNO is an Ellipsis, whose Center is carried round the Earth in the Orbit AEBFCGDH: Its longer *Axis* LN, always parallel to BD, joining the *Earth* and *Sun*, TS, is double its shorter *Axis* MO. While the *Fig.* LMNO is carried to the *Left*, from A to E, B, F, C, G, D, H, *&c.* the *Moon* revolves *contrary*, from M to P, N, Q, O, R, L, V, M, describing equal *Areas* in equal Times about the Center of this *elliptic Epicycle*, so as to perform a *Revolution* therein, in the same Time that the Center of the said *elliptic Epicycle* performs its Revolution, in the *circular Orbit*.

The *Moon* is always in the remoter Extremity of its *shorter Axis* in M, and O, when in her *Quarters* from the *Sun*; and in the nearer Extremity of its *longer Axis*, at the Time of *New* and *Full* Moon. The shorter Semi-Axis of this Ellipsis MA, is to the Distance of its Center from the Earth, AT, in the *duplicate Proportion of the Moon's periodical Time about the Earth to the Sun's periodical Time; being as* 47 *to* 8400, *nearly*.

The *Figure* MPNQORLVM described by this compound Motion of the Moon in the *elliptic Epicycle*, while the Center thereof is carried round the Earth, very nearly represents the *Form* of the Moon's Orbit; supposing it without Eccentricity, and that its Plane was coincident with the Plane of the Ecliptic; and also that the Sun continued in the same Place, during the Moon's whole Revolution about the Earth.

Of MACHIN's THEORY of the MOON's MOTION.

PROPOSITION. *A Body being deflected by two Forces, tending constantly to two fixed Points, will describe, by Lines drawn from those fixed Points to the Body*, equal Solids *in equal Times, about the* Line *joining the said fixed Points.*

This *general Law* of *centripetal Forces*, according to *Kepler*, is, that all Bodies describe equal *Areas* in equal Times, about the single Center of their respective Revolutions; but as *this Law* has been proved *defective*, by Sir *Isaac Newton*, when a Body gravitates to two different Bodies at the same Time, as every *Satellite* gravitates towards its *Primary*, while it gravitates also towards the Sun, Mr. *Machin*, to supply the *Defect* of *Kepler's Law*, of Gravitation to one Center only, has explained the Motions of the *Moon*, and of the other *Satellites*, by the Law of the above *Proposition*, according to a Gravity tending to two different Centers at once.

COROLLARY. *If a Body gravitates towards two* fixed Centers, *be supposed, for given* small *Intervals of Time, moving in a* Plane *passing through one of those* fixed Centers, *the Inclination of the said Plane to the Line joining both the Centers, will vary according to the* Area *described: That is, if the Area be* augmented, *the Inclination will be diminished; and if the Area be* diminished, *the Inclination of the said* Plane *will be augmented; that the* Solids *described, according to the Proposition, may be equal.*

THIS *Corollary*, being rightly applied, will serve to *explain* the Variation of the Inclination of the *Plane of the Moon's Orbit* with the Plane of the *Ecliptic*; without entering into the *intricate* Calculations contained in the *Corollaries* to 34 *Prop.* of the III. *Book* of the *Principia*, to determine the greatest Quantity of *Variation*, when the *Line* of *Nodes* is in Quadrature with the Sun; which, in particular Numbers, is found to be 2′ 43″, or 2′ 45″, according to *Newton*.

But in this Case before us, we have a *plain and general Rule*, from the foregoing *Premises*; *namely*, that the *greatest Variation*, in the said Position of the Moon's *Orbit*, is to the *mean Inclination* of the Plane thereof, as the *Difference* of the greatest and least Areas, described in the same Time, by the Moon about the Earth, when in the *Conjunction* and in the *Quadratures*, to the *mean Area*.

Hence, if S be to L, as the Sun's to the Moon's Period; then the *greatest* is to the *least* Area, as $\sqrt{SS+3LL}$ to S, or as $S+\frac{3LL}{2S}$ to S, *nearly*. So that the *Difference* of the *Areas*, is to the mean Area, as $\frac{1}{2}$LL to SS + $\frac{1}{4}$ LL; in which Proportion is the *Variation* of the Inclination of the *Plane* of the Moon's Orbit, at this Time, to the *mean* Inclination thereof; agreeing, nearly, with Sir *Isaac Newton's* Computation.

MOREOVER,

Of MACHIN's THEORY of the MOON's MOTION.

MOREOVER, there is a *general Method*, as Mr. *Machin* observes, for assigning the *Laws* of the Motion of a Body to and from the Center, abstractedly considered from its Motion about a Center. And this Motion, to and from the Center, is called by *Kepler*, the *libratory* Motion of that Body, distinct from its circular Motion: The Knowledge of which Motion Mr. *Machin* thinks necessary for defining the Laws of the Revolution of a Body, in Respect of the Motion of the *Apsides* of its Orbit; which Revolution, from one *Apsis* to the other, is performed in the Time of the whole *libratory* Motion of the Body; the *Apsides* of the Orbit being the extreme Parts thereof, in which only the libratory Motion, to and from the Center, ceases.

According to *this Theory*, the Motion of a *Body* round the *Center* of Revolution, is not considered as a continued Deflection from a *strait* Line; but as compounded of a *circulatory* Motion round the Center, and of a *rectilinear* Motion to and from the Center of Revolution. To each of which Motions, Mr. *Machin* assigns its proper *Equant*.

The general Property of an Equant for any Motion, is a *Curve-Line described about the Center thereof, whose* Rays *are reciprocally in the subduplicate Velocity at the Center, or Velocity of Revolution.*

The EQUANT for the *libratory* Motion, is a *curve-lined* Figure, the *Areas* of which are *proportional* to the Times wherein the *several Spaces* of Libration are performed; which *Figure* is determined by the Law of Gravity, towards the Center, being known. For the *libratory Force*, to accelerate or retard the Motion, to or from the Center, is the *Difference* between the Gravity of the Body towards the Center, and the *centrifugal* Force arising from the *circulatory* Motion; the latter being always subject to *one Rule*: Because, in all the Revolutions about a Center, in any Curve, whether described by a centripetal Force, or not, the centrifugal Force will be directly, *in the duplicate Proportion of the Area described in a given Time, and reciprocally, in the triplicate Proportion of the Distance*; being an immediate Consequence of a known Proposition of *Huygens*. And the like Proportion also holds as to the centripetal Force, in all *circular* Motions whatsoever, from a known *Prop.* in Sir *Isaac Newton*. And what is true of the *centripetal* Force in Circles, is *universally* so of the other Force, in Orbits generated of any Form.

Moreover, that by knowing the *Gravity* of the Body, the other Force being always known, the Difference thereof (being the *absolute Force* to move the Body to and from the Center) will be also known. And, from thence, the Velocity of the Motion, and the Space described, in a given Time, may be found; and also the *Equant* described.

Example. If the Gravity be *reciprocally as the Square of the Distance*, the Equant for the libratory Motion, will be found to be an *Ellipsis*, similar to the Orbit, whose longer *Axis* is double the *Eccentricity*. And the Center of the *libratory* Motion, that is the Place where it is *swiftest*, will be in the *Focus* of that Orbit. The Time of *Libration*, through the several Spaces, will be measured by the *Sectors* of the said *Ellipsis*, similar to those described by the Body round the *Focus* of the Orbit. And the Period of the *libratory* Motion will be the same with the Period of the Revolution.

In any other Law of Gravity, the *Equant* for the libratory Motion, will be either of a Form different from the Orbit, or if of the same Form, will not be alike divided.

The *Equant*, for the *libratory* Motion of the Moon, is a *Curve* of the *third Kind*, whose Equation is of *four Dimensions*; but may be described by an *Ellipsis*; the Center of Libration not being in the *Focus*.

From this Method of resolving the Moon's Motion, it is not difficult to shew the *general Causes* of the Change of Eccentricity, and the *Inequality* of the Motion of the Moon's *Apogee*. For, when the Line of *Apsides* is moving towards the *Sun*, it is easy to shew, that since the *external Force* in the *Apsides* is then *centrifugal*, it will contribute to lengthen then the Space and Time of *Libration*. By lengthening the Space, it augments the Eccentricity; and by lengthening the Time of *Libration* it also prolongs the Time of the Revolution to the *Apsis*; causing what is *improperly* called a progressive Motion of the *Apsis*. But when the *Line* of *Apsis* is moving to the *Quadratures*, the external Force in the *Apsides*, is then *centripetal*, which will contribute to shorten the Space and Time of the *Libration*. And, by shortening the Space, the Eccentricity will thereby be lessened; and by shortening the Time of Libration, the Time of Revolution to the *Axis* will thereby be contracted; causing what is *improperly* called a retrogade Motion of the *Apsis*.

REMARKS. The Motion of the Moon, in the before described *elliptic Epicycle*, only shews the *Elongation* of the Moon from the Center of that *Epicycle*; but does not describe an accurate *Ellipsis*, according to the *Newtonian Theory*.

When the Moon is in that Half of its Orbit next to the Sun, it then being nearer than the Earth to the Sun, it will have a greater Gravity than the Earth to the Sun; which *Excess* of Gravity, according to the *Newtonian Theory*, consists of *two Parts*; one acting in the Line PE, *parallel* to that which joins the *Earth* and *Sun*; and the other acting in the *Line* E , directed to the Earth. And these *two Forces* being compounded into *one*, constitute a Force directed in the Line P*e*, (*see Fig.* V.) which is in Proportion to the Force of Gravity, as that Line P*e*, is to T*e*, *nearly*. Hence, as there is a Force constantly impelling the Moon somewhere towards the Point *e*; this Force is supposed to *inflect* the Motion into a *Curve-Line* about that *Point*; for the same Reason as the Gravity of it to the Earth is supposed to inflect its Motion into a Curve-Line about the Earth: Not that the Moon can actually have so many distinct Motions; but that *one simple Motion* of the Moon round the Sun is supposed to *result* from a Composition of these several Impulses, or Motions.

If Æ represent the Equation of the Sun's Center, S the Sun's *Period*; P, the *synodical* Period of the *Moon* to the *Sun*; L, the Moon's Period to the *Stars*; Then, $\frac{3LL}{2PS} \times Æ =$ the *annual* Equation of the Moon's *mean Motion*.

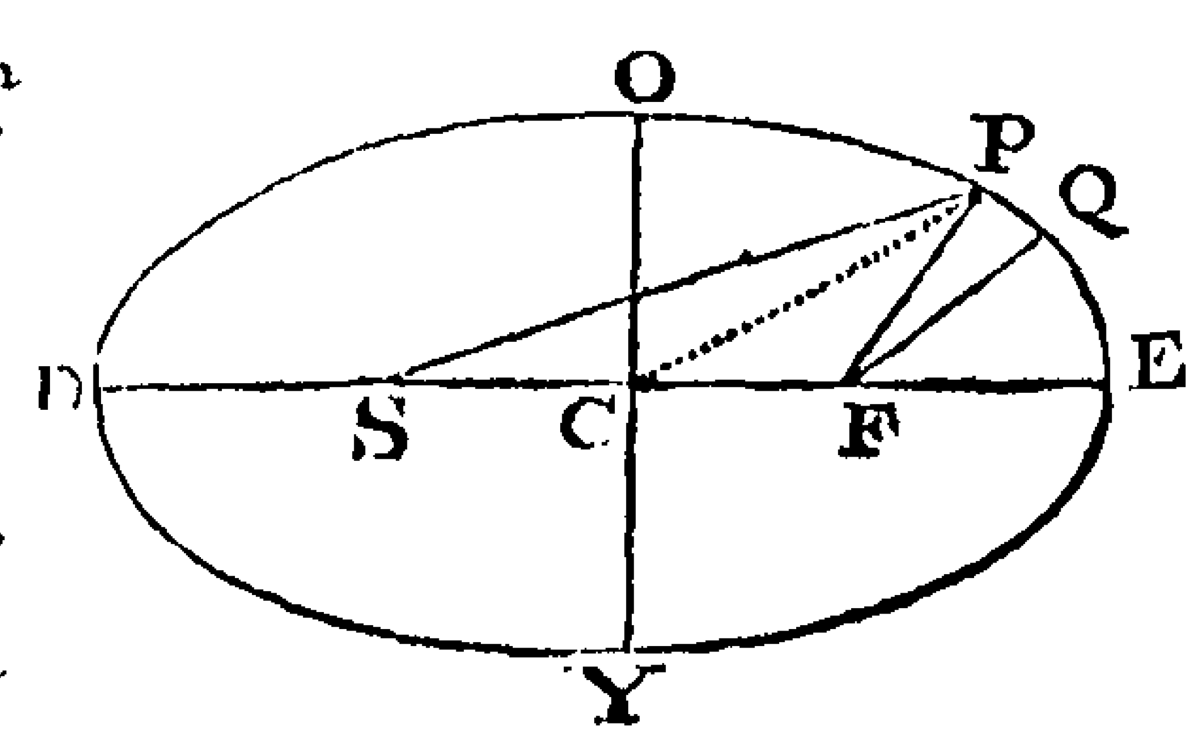
If Æ represent the Equation of the Sun's Center; P, the mean periodical Time of the *Apogee* or *Node*; S, the mean *synodical* Time of the Sun's Revolution to the Apogee or Node: Then will $\frac{3S}{2P} \times Æ$, $=$ the *annual Equation* of the *Apogee* or *Node*, according as S and P are defined.

According to which *Rules*, the Equation of the *Sun's Center* to $\left\{\begin{array}{l} \textit{ann. Equat.} ☽ \\ \textit{ann. Equat.} ☽\textit{'s Ap.} \\ \textit{ann. Equat.} ☽\textit{'s Node} \end{array}\right\}$ will be in a given Proportion, *respectively*.

☞ The above general Propositions and Proportions, *mutatis mutandis*, serve for any other *Satellite*, as well as for the *Moon*.

Mr. *Machin* shews a *Method* of correcting the Angle of mean Anomaly at the upper *Focus* (by an *elliptic Equant*, *see P.* 82.) so as to give the true Anomaly, according to the Proportions of *Ward's* Hypothesis.

A METHOD of finding the DIFFERENCE *between the* Angle of a Planet *at the* upper Focus (*according to* Ward's Hypothesis) *and the true Angle thereof from* Aphelion. *According to the late* Abraham De Moivre, F. R. S. *See his Analytica.*



IF EPD be an *Ellipsis*; C, the Center; S, F, the *Foci*; DE, OY, the two *Axes*; and a *Planet* revolves about the Center of Force in the *Focus* S, and you make ∠EFQ the mean Anomaly : 2 right Angles :: as the Area PSE : to the Area DOPE of the *Semi-Ellipsis*.

You may find PFQ $=$ *the* Difference *of the Angles* EFP, EFQ, *as follows*.

Let CD$=r$, CO$=m$, SP$=x$, FP$=y$, *&c.* *Then*, by the *Method of Fluxions*, CP $= \sqrt{rr + mm - mr}$.

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THE Angle of the Moon's *Elongation* from the *Center*, represented by *e*TP is the *Variation* or Reflexion of the Moon; the *Properties* of which appear from *Figure* V.

The *Variation-Equation* is the Sine of the double Distance of the Moon from the Quadrature or Conjunction with the Sun; it being the Difference of the two Angles *e*TA and PTA, next the Sun, whose Tangents, by Construction of the Figure, are in a given Proportion.

The *Variation-Equation* is, all other Circumstances being alike, in the *duplicate* Proportion of the *synodical* Time of the Moon's Revolution to the Sun. For the *Variation* is in Proportion to the mean Diameter of the *Epicycle*, in the *duplicate* Proportion of the synodical Time of Revolution.

The GREATEST VARIATION is an Angle whose *Sine is to Radius as the Difference of the greatest and least Distances* TM *and* TN *next the Sun, that is* 3 AM *to their Sum.*

According to which Proportion of the *Lines* described, *this Rule* makes the Elongation near 29 Minutes, which would be the *Variation*, supposing the Moon performed its Revolution to the Sun in the Time of its Revolution about the Earth. But this *Elongation* of 29′ being increased in the *duplicate* Proportion of the synodical to the *periodical* Time of Revolution, it will give nearly 34′ of *Variation*.

☞ What is said of the *Epicycle* is upon Supposition, that the Earth's Orbit round the Sun is a *Circle*. But if the *Eccentricity* of the elliptic annual Orbit be considered, the mean Diameters of the *Epicycle* must increase or decrease in the *reciprocal triplicate* Proportion of the Sun's Distance.

Mr. *Machin* next shews a general Method of finding the *Inequality* by an *Equant*, in any Revolution, when the *hourly* Motion, or Velocity of the revolving Body varies, in Respect of its Aspect to some other revolving Body.

That, in any Revolution, the *mean Motion* and *Inequality* are to be assigned by Means of a *curvilinear Figure*, wherein *equal Areas* are described about the Center in *equal* Times; the Property of which *Figure* is, that the *Rays* from the Center, are always in the *reciprocal subduplicate* Proportion of the hourly Velocity about the Center.

He gives an *Instance*, in a Figure called the *elliptic Equant*, of the Sun's *periodical* Revolution to the *Node*, to the periodical Time of the Sun's Revolution, as the Area of the *elliptic Equant* to the Area of the circumscribing *Circle*.

That, if a Circle be described, about the Center of the curvilinear *Figure*, and equal to its Area, it will cut the Figure in the Place where the *Sun* has the mean Motion from the *Node*.

That, if any *circular Sector* be made, which shall contain an *Area*, equal to the Sector in the Figure, drawn through a Perpendicular's Intersection of the *Fig.* let fall from the Extreme of the Arch of the *circular Sector*, on the Diameter, the Angle of the *circular Sector* will be the Angle of *mean Motion* of the Sun from the Node.

That the Difference between the Angle of the *circular Sector*, representing the Sun's mean Motion from the *Node*, and the Angle of the *Figure's Sector*, representing the true Motion of the Sun from the Node, will be the *Equation* of the Sun's Motion from the Node.

That by the *same Rule*, an Equation may be determined of the Moon from the Sun; or Moon from the Apogee or Node; by a *curvilinear Figure* described about the Center; the Relation of which *Areas* shall represent the *mean* and *true* Motions; whence the Inequality or *Equation* of these Motions will be shewn.

That, as in every Revolution, there is a certain Figure proper to shew this Inequality of Motion, *such a Figure* may therefore be properly called the *Equant* for that Motion or Revolution.

That, in every Revolution, where the *Equant* has the same Property, the *Inequalities* or *Equations* will vary according to the same *Rule*.

EXAMPLE. If the *Equant* be an Ellipsis about the Center, as in the Figure of the Motion of the *Sun* from the *Node*.

1. The mean Motion in the whole Revolution will be a *geometrical* mean Proportional between the *greatest Motion*, in the Extremity of the shorter Axis, and the *least Motion*, in the Extremity of the longer Axis; because the *Radius* of the Circle, which is equal to an Ellipsis, is a mean Proportional between the two *Semi-axes*.

2. That the *Tangents* of the Angles of the *mean* and *true* Motion are in the given Proportion of the two *Axes* of the Ellipses; being as the respective *Ordinates* to those Motions.

3. The *Sine* of the Angle of the *greatest* Inequality in the *Octants*, is to the *Radius* as Half the Sum of the *Axes* to Half their Difference.

That the *Equant* is an Ellipsis about the Center, in every Motion where the *Excess* of Velocity *about the Center*, above the least Velocity is always in the *duplicate* Proportion of the *Sine* of the Angle of the true Motion from where the Velocity about the Center is *least*.

Whence it follows that these Motions are represented by an *elliptic Equant, viz. The monthly Motion of the Moon from the Node; the annual Motion of the Sun from the Node, and of the Moon from the Sun; accelerated or retarded*, according to the Change of the Area described about the Earth; (as in *Newton's* 26 *Prop.* III. *Book.*) Also the *annual* Motion of the *Sun from the Moon's Apogee*.

Thus, he instances, in the Motion of the Nodes, that the Node is in its swiftest retrograde Motion, when the *Sun* and *Moon* are in Conjunction or Opposition, and in Quadrature with the *Line of Nodes*.

According to Sir *Isaac Newton's* Method, (at the End of the 13 *Prop.* of the III. *Book*) the *Force* of the Sun to produce a Motion in the Node, at this Time, *is equal to* 3 *Times the mean solar Force*; *that is, by Construction of the elliptic* Epicycle, *in Fig.* V. *equal to a Force which is to the Force of Gravity, as* 3AM *to* AT, *or* 3 *Times the* shorter *Semi-axis of the elliptic* Epicycle *to the Distance of the Center thereof from the Center of the* Earth.

But, if the Moon revolves in an *elliptic Epicycle*, as before described, the Force, to make a Motion in the Node mentioned, will be to the Force of Gravity at the Time, as 3BN *to* BT, *or thrice the longer* Semi-axis *of the elliptic* Epicycle, *to the shorter Semi-axes of the Moon's Orbit*; *being double the former Force*. But, according to Sir I. NEWTON's METHOD, the Motion of the Node, at this Time, is to the Moon's Motion, as *the solar Force to create a Motion in the Node is to the Force of Gravity*. And, if the Moon be conceived revolving in a Circle, with the Velocity of its Motion from the Node, at this Time, when the Node is swiftest, and the *Plane* of the said Circle be supposed to have a Rotation upon an *Axis* perpendicular to the *Plane* of the Ecliptic, and the contrary Way to the Moon's Motion, so as to produce the Motion of the Node; leaving the Moon to move with its *own Motion* about the Earth; the Force to make a Motion in the *Node* seems to be the Difference of the *former* Forces to retain it with the Velocity of its Motion in the moveable and immoveable *Planes*. But the Velocity of Bodies, revolving in Circles, *are in the subduplicate Proportion of the central Forces*.

The Motion of the Moon from the Node, at this Time, when the Node moves swiftest, is to the Motion of the Moon, in the subduplicate Proportion of the Sum of the Forces *to the Force of Gravity, or as the* Sum *of* TB *and* 3BN *to* TB; *that is, as the* Sum *of the* shorter *Semi-axis of the Moon's Orb and* 4 *Times the longer Semi-axis of the* elliptic Epicycle, *to the Sum of the said* shorter *Semi-axis and once the* longer *Semi-axis of the said* Epicycle.

This would be the *greatest Motion of the Node*, provided that the *Plane* of the Moon's Orbit was nearly coincident with the Plane of the Ecliptic; but the Inclination thereof being considered, the motive Force for the Node must be diminished in the *Proportion of the Cosine of Inclination to* Radius.

The Distance TB, before-mentioned, being equal to 8400, and 3BN being 282, the Inclination of the *Plane*, in this Position, is 4° 59′ 35″; the *Cosine of which to Radius is as* 525 *to* 527 *nearly*; therefore the Force of Gravity is to the motive Force of the Node, thus diminished, in the compound Proportion of 8400 to 283 and 527 to 525; being nearly as 4216 to 141. So that the *greatest* Motion of the Moon from the Node, is to the Motion of the Moon, in the *subduplicate* Proportion of 4357 to 4216, or nearly as 613 to 603. According to which Computation, the greatest hourly Motion of the Node comes out 32″ 47‴; but, by Sir *Isaac Newton's* Method, it amounts to 33″ 10‴ ½.

This is the *swiftest* retrograde Motion of the Node when the *Line* of the Nodes is in Quadrature with the Sun, and the Moon is in the *greatest* Latitude, in Conjunction or Opposition to the Sun.

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But the *Equant* for the Motion of the Moon from the Node in this Month, when the *Line* of the Nodes is in the Quadrature with the Sun, is an *Ellipsis* about the Center; and therefore the *mean* Motion, in this *Month*, will be found by the following RULE.

The *mean Motion of the Moon from the Node, in that Month when the Line of the Nodes is in a Quadrature with the Sun, is a* geometrical *mean Proportional between the greatest Motion of the Moon from the Node, and the Motion of the Moon.*

This Motion will be to the *mean* Motion of the Moon, in the *subduplicate* Proportion of 613 to 603, *nearly* as 1221 to 1211. That the Motion of the *Node*, in this Month, will be to the Motion of the Moon, as 10 to 1211; making the *mean* hourly Motion 16″ 19‴ $\frac{1}{4}$. But, according to Sir *I. Newton*, it amounts to 16″ 35‴; yet by Corrections that he pursues, it reduces to 16″ 16‴ $\frac{2}{3}$.

The EQUANT for the annual Motion of the Sun from the Node being also an Ellipsis, it follows that

The mean Motion of the Sun from the Node is a geometrical mean Proportional, between the Motion of the Sun and the mean Motion of the Sun from the Node, in the Month when the Line *of the Nodes is in a Quadrature with the Sun.*

The mean Motion of the Node, when the *Line of Nodes* is in Quadrature with the Sun, is already shewn to be, to *the Moon's mean Motion, as 10 to 1211; and the Motion of the Sun is to the Motion of the Moon, as 160 to 2139; whence, the Motion of the Node and Motion of the Sun will be as 1549 to 1395.* Therefore, by the said *Rule*, the Sun's mean Motion from the Node, is to the Sun's mean Motion, in the *subduplicate Proportion of 1549 to 1395*, being *nearly as 98 to 93*, corresponding with Observation; *there being 98 Revolutions of the Sun to the Node in 93 Revolutions of the Sun.* — The subduplicate Proportion taken more nearly, is 941 to 893, which will give 19° 21′ 3″, for the Motion of the *Node* from the *fixed Stars*, in a sydereal Year. The Motion observed is 19° 21′ 22″.

If the *Computation* from the *Rule* had been more exactly made, the *annual* Motion produced had been 19° 21′ 7″ $\frac{1}{2}$, which is 14″ less than the Motion observed by Astronomers.

The foregoing Difference of Motion, probably, may arise from the Sun's *Parallax*; and if so, may furnish the *best* and most certain Method of determining the *true* Distance of the Sun. For the Sun's Force being something more on that *Half* of the *Moon's* Orb which is towards the Sun, than it is on the other Half, the *elliptic Epicycle* must be accordingly larger in the *first Case* than in the *latter*. And by Computation, the *mean* Motion of the *Node* arising (after Consideration is taken of this *Difference*) is more than the mean Motion from the mean Magnitude of the *Epicycle*, by near 2″ in a Year, for every Minute of the *parallactic Angle* of the Moon's Orbit. And, by the best Computation, this *Difference* of 14″, in the annual Motion of the *Node*, will arise from about 8″ of *Parallax*, making the Sun's Distance above 25000 Semidiameters of the Earth.

As the *Equant*, for the Motion of the Node, in that Month when the *Line* of the Nodes is in *Quadrature* with the Sun, is an *Ellipsis*; so, in any other Month, it is also an *Ellipsis*: the Motion of the *Node* being direct and retrograde by Turns, in the Moon's passing from the Quadrature with the Sun to the Place of its Node, and from thence to its Quadrature aforesaid.

The *Inclination* of the Plane of the Moon's Orbit to the Plane of the Ecliptic is also shewn by these *elliptic Equants*, (see P. 25. *Laws of the Moon's Motion, at the End of the Principia, translated by Motte.*)

The *Motion of the Moon* from the Sun, accelerated and retarded by the *Increment* of the Area described by the Moon about the Earth (*according to 26. Prop. III. Book, Principia*) is also reduced to an *elliptic Equant*, by taking the shorter to the longer Axis, in the *subquadruplicate or 4th Root, Proportion of the Force of the Moon's Gravity to the Earth to the said Force added to 3 Times the mean solar Force*; that is, as TA (in Fig. V.) *to the first 3 mean Proportionals between* TA *and* TA + 3AM.

In this Proportion is the *Area* described by the Moon about the Earth, when in Quadrature with the Sun, to the *mean Area*: Or, as the *mean* Area to the Area described, in the *Syzygies*. Hence, the *greatest* Area in the *Syzygies* is to the *least* in the Quadratures, in the *subduplicate* Proportion of TA + 3AM to TA, or as $\sqrt{8541}$ to $\sqrt{8400}$.

But this is on *Supposition*, that the Moon revolves to the *Sun* in the same Time that it revolves about the *Earth*; which nearly agrees with Sir *I. Newton*'s Computation in the before-cited *Proposition* 26. B. III.

In like Manner, an *elliptic Equant* may be constructed to shew the mean Motion of the Moon's Apogee, according to the *Rules* given by Sir *Isaac Newton* (in *Corollaries* of 45. Prop. I. Book) for stating the Motion of the *Apogee*; *viz.* by taking the greatest retrograde Motion of the Apogee from *the Force of the Sun upon the Moon in the Quadratures*; *and the greatest direct Motion, from the Force of the Sun upon the Moon when in Conjunction and Opposition*; each, *according to his Rule delivered in the 2d Corollary to the said Proposition*. And, if an *Ellipsis* be made, whose *Axes* are in a *subduplicate* Proportion of the Moon's Motion from the *Apogee*, when in the said swiftest *direct* and *retrograde* Motions, the said *Ellipsis* will be nearly the *Equant* for the Motion of the Moon from the Apogee, and be nearly in the Form of that above, for the *Increment* of the Area. But the Motion of the Apogee, by this Method, will be found to be no more than 1° 37′ 22″, in the Revolution of the Moon from *Apsis* to *Apsis*, which should be 3° 4′ 7″ $\frac{1}{2}$, according to *Observation*. — By which, there is more Force necessary to account for the Motion of the Moon's Apogee than what arises from the *Variation* of the Moon's Gravity to the Sun, in its Revolution about the Earth.

But, if the Cause of this Motion be supposed to arise from the *Variation* of the Moon's Gravity to the Earth, as it revolves round, in the *elliptic Epicycle*, this Difference of Force, nearly the *double* of the former, will be sufficient to account for the Motion; but not so *exactly* as might be expected.

Mr. *Machin* proceeds to lay down a *Rule*, (founded on new Principles) which is, that *The mean Motion of the Moon from its Apogee, is to the mean Motion of the Moon, in the subduplicate Proportion of the Dif. between twice the mean Semidiameters of the Epicycle, and the Moon's mean Dist. to her mean Dist.* See Fig. V; *where* AM = 47, AN = 94, *and* AT = 8400.

EXAMPLE. Half the shorter Axis of the Epicycle, is 23$\frac{1}{2}$, deducted from AT (= 8400) = mean Distance from the Center of the Moon's Orb, 8376$\frac{1}{2}$; the Sum of the Semiaxes of the *Epicycle*, 141; the Difference of the *mean* Distance 8376$\frac{1}{2}$, and Sum of the said *Semiaxes*, of the Epicycle, = 8235$\frac{1}{2}$. Wherefore the Motion of the Moon from the Apogee is to the Motion of the Moon, as the *Subduplicate* of 8235$\frac{1}{2}$ to 8376$\frac{1}{2}$, as 1877 to 1893; so that there ought to be 16 Revolutions of the Apogee in 1893 Revolutions of the Moon; agreeing, to great Precision, with the *modern* Numbers observed. Whence the mean Numbers of the Apogee, in a sydereal Year, will be 40° 40′ 40″ $\frac{1}{2}$; *nearly* agreeing with the Numbers from *Newton*'s *Theory*, 40° 40′ 43″, as before observed in the *Comment*.

The mean Motion of the *Apogee* being stated, according to the *physical* Rules aforesaid, the following *Rule* serves for determining the Variation of Eccentricity of the Moon's Orbit.

RULE. *The least is to the mean Eccentricity in the duplicate Proportion of the Sun's mean Motion from the Apogee of the Moon's Orbit, to the Sun's mean Motion. Or in the duplicate Proportion of the periodical Time of the Sun's Revolution to the mean periodical Time of its Revolution to the Moon's Apogee.*

By the foregoing *Rule* for the mean Motion of the Apogee, there are 16 *Revolutions* of the Apogee in 1893 *Revolutions* of the Moon; but there being 254 Revolutions of the *Moon* in 19 Revolutions of the *Sun*; there must be about 7 Revolutions of the *Apogee* in about 62 Revolutions of the *Sun*; or rather about 20 in 177.

That the Period of the *Sun* to the *Stars*, and of the Sun to the Moon's Apogee, are, *nearly*, as 157 to 177; the Duplicate of which Proportion is, that of 107 to 136; which, according to the *Rule*, should be the Proportion of the *least* to the *mean* Eccentricity.

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Hence, by this *Rule*, the *mean* Eccentricity (or *Half* the Sum of the greatest and least) ought to be the Difference of the mean from the least, *(or Half the Difference of greatest and least)* as 136 to 29.

The mean *Eccentricity* according to *Flamstead* or *Horrox*, is ,055236; to mean Distance of Sun 1; Half *Difference* between greatest and least ,011617; being *nearly* as $135\frac{1}{2}$ to $28\frac{1}{2}$.

According to *Newton*, the mean Eccentricity ,05505 to 1, the mean Distance or Semi-Transverse of the Earth's Orbit; Half the Difference of greatest and least ,01173; nearly as $135\frac{4}{8}\frac{7}{}$ to $28\frac{4}{8}\frac{7}{}$, very nearly as above.

The *Rule* here laid down is only to be used, for determining the *variable* Eccentricity, when the Eccentricity of the Orbit is *small*.

The greatest and least Eccentricity being known, the *Equant* for the Motion of the Sun from the Apogee will be an *Ellipsis*; whose greater and less *Axis* are equal to the greatest and least Eccentricities. And therefore by the Property of such an *Equant*,

The Sine of the greatest Equation *of the Apogee will be to* Radius, *as the Difference of the Axes of the* Equant *is their* Sum; that is, *as the Difference of the greatest and least* Eccentricities *to their Sum*.

EXAMPLE. The Difference to the Sum (before determined) as 29 to 136 :: Radius : 12° 18′ 40″, as before determined in the *Comment*.

Hence also, Mr. *Machin* gives *this Rule*, for determining the Equation of the Apogee in any Aspect of the Sun to the Apogee.

The Tangent of the Angle of the mean Distance of the Sun from the Moon's Apogee is to the Tangent *of the Angle of the true Distance of the Sun from the said Apogee, as the greatest is to the least* Eccentricity, *or as* 165 *to* 107, nearly.

Mr. *Machin* then proceeds to shew that a Curve may be described about a Center, to represent the *Inequality* of any Motion proposed, whose Rays are *reciprocally in the subduplicate Proportion of the Velocity about the Center*. That, where the Inequality about the Center is but *small*, there is no Need of *great* Exactness in the Quadrature of the Curve for shewing what the Equation is. Whence all the *small* annual Equations *(he shews)* of the Moon's Motion, arising from the different Distances of the Sun, at different Times of the Year, are reduced to *one Rule*, near enough for the Purpose.

That since the Sun's Force to produce these annual *Inequalities*, is reciprocally in the *triplicate* Proportion of his Distances, the Rays of the Equant, for such a Motion, will be in the *sesquiplicate Proportion* of that Distance, &c. *as before described*; who determines the small Equations of the *Moon*, *Apogee*, and *Node*, accordingly, as has been noted.

He proceeds to an Example of the *Use* of the Equant, in finding the Equations of the Moon's Center, by a complicated *Figure*, (see the End of *Newton's Principia*, translated by *Motte*) but as we have already given a Sketch of *this Rule* in P. 82. we need not repeat it here. — What we have introduced is to give the Reader the completer *Idea* of *physical Astronomy*; which Sir *Isaac Newton* first promoted; and has since been improved by several *mathematical* Astronomers, *De la Caille*, &c.

Mr. *T. S. F. R. S.* the celebrated Author of the *miscellaneous Tracts*, distinguished for his eminent Abilities, has given a Correction of *Ward's Hypothesis*, (at P. 53 of the said *Tracts*) by Means of *one*, *two*, *three*, or more Equations, representing that Mr. *Machin* has given *one* of his three Equations *defective*; injudiciously asserting, that *the Inequality in the Motion of a* Planet *about the upper Focus consists of three Parts*; " As if (says the Tract Author) the Nature of the Subject admitted " of just *that Number*, and no more; whereas the Parts or Equations " arising in the Consideration, are without Number; being the Terms " of an *infinite Series*, wherein the Eccentricity is the converging " Quantity. Sir *Isaac Newton* has given two Terms of this *Series*, " which are right; but the *new* Equation added by the *Commentator* " (Mr. *Machin*) is not so; the *Sign* thereof, the *Coefficient*, and the " *Law* by which it increases and decreases, being all different from " what they *ought to be*."

Moreover, (in P. 54 *of the said Tracts*) the Tract Author has criticised the same *Commentator* for giving the *Ratio* of the Diameters of the Moon's Orbit *(setting aside the Consideration of* Eccentricity) as 59 to 60; Sir *Isaac Newton* having otherwise *physically* proved it to be as 69 to 70; with which the Tract Author's physical Computation wonderfully agrees.

Of DE LA CAILLE's THEORY, and PHYSICAL RULES, of the MOON's MOTION.

(See this celebrated AUTHOR's ASTRONOMY for the DEMONSTRATION.)

I. THE *different Inequalities in the Motion of the Moon are produced by the different Modifications its central Force to the Sun occasions in its central Force to the* Earth.

II. *The Moon's perturbate Force is always the* third *Side of a right lined Triangle, one Side whereof is the* Radius *of the Moon's Orbit, and the other Side is the* triple *of the* Cosine *of the Moon's Distance to the nearest* Syzygy.

III. *Therefore the Force accelerating or retarding the Moon's Motion in its Orbit, is always as* $\frac{3}{2}$ *of the* Sine *of twice the Moon's Distance from the* Line *of the Syzygies.*

IV. *And the Force diminishing or increasing the Moon's central Force or Gravity, respectively to the* Earth, *is as the Sum, or as the Difference of Half the Radius, and of* $\frac{3}{2}$ *of the Cosine of twice the Moon's Distance from the Line of the Syzygies.*

V. *All the* Inequalities *happening to the Moon's Motion, in its Passage from one Syzygy to its next Quadrature, are gradually restored in the Moon's Passage from this Quadrature to the next Syzygy; afterwards the like Inequalities begin again in the same Order from this Syzygy to the next Quadrature, and are again restored in the Passage to the following Syzygy, and so on.*

VI. *When the Moon is in the Syzygies, its perturbate Force diminishes the central Force, respectively to the* Earth, *and increases it when in the Quadratures: But the Diminution in the Syzygies, is double the Augmentation in the Quadratures.*

VII. *There are four Points in the Moon's Orbit, each about* 54° 44′ *from either Side of the* Syzygies, *where the Gravitation of the Moon to the Sun makes no Alteration in its central Force in respect to the* Earth.

VIII. *The Variation of the Moon's central Force respectively to the* Earth, *tends to flatten its Orbit towards the Syzygies, and to lengthen it towards the Quadratures; so that the Moon's Orbit, at first* circular, *is now become* oval *or* elliptic; *its greater* Axis *being in the* Line *of Quadratures, and less Axis in that of the Syzygies, and the* Earth *in one of the Foci.*

IX. *The* Velocity *of the Moon must decrease from the Syzygies to the Quadratures; and accelerate from the Quadratures to the Syzygies.*

X. *The Quantity whereby the Moon's* Velocity *is diminished in going from the Syzygy to the Quadrature, or accelerated from the Quadrature to the Syzygy, must increase from the Syzygy to the next* Octant; *and decrease in the same Proportion, from that* Octant *to the following Quadrature:* It being always in the *Ratio* of the Sine of twice the Moon's Distance from the Syzygy. This Inequality is called the Moon's *Variation.*

Of DE LA CAILLE's THEORY, and PHYSICAL RULES, of the MOON's MOTION.

XI. *In the Syzygies and Quadratures, a* Ray *from the* Moon *to the* Earth *will describe Areas in Proportion to the Time; in every other Point of the Orbit, the Areas are less in Proportion to the Times, as the Moon is nearer its* Octants.

☞ The *Moon's Orbit* has been supposed a *Circle*; though it is in Fact an *Ellipsis*; in one of whose Foci the Earth is placed. Whence the explained *Inequalities* may cause the Ellipsis to be more convex in the Quadratures, and more rectilinear in the Syzygies. Which *Inequalities* must contribute *to make the Moon recede from* the Earth in the Quadratures, and approach it in the Syzygies; though the Moon's elliptic Orbit is not very eccentric. And since the Moon's *central* Force diminishes in the Syzygies, and increases in the Quadrature, it is evident (from *what is demonstrated* in *De la Caille's Astronomy*) it must sometimes be too great, and sometimes too little, to be *inversely* as the Square of the Moon's Distance from the Earth.

The Difference in the Moon's *Distances*, the *Variation* of the Eccentricities of the Earth and Moon, the *Inclination* of the Plane of the Moon's Orbit to that of the Ecliptic, constitute, and are the Cause of, five very considerable periodical *Inequalities* in the Moon's Motion.

1. An *Inequality* in the Time of several of the Moon's successive periodic *Revolutions*.
2. The Motion of the *Line of the Apsides*.
3. A continual Change in the Eccentricity of the Moon's Orbit.
4. The *Retrogradation* of the Moon's Nodes.
5. The Change in the Inclination of the Moon's Orbit.

XII. *The Times of the Moon's periodic Revolutions are longer when the* Earth *is in its Perihelion than when in its Aphelion.*

XIII. *When the Moon is in the Syzygies, the* Line *of its* Apsides *advances directly, according to the Order of Signs; but moves retrograde when the Moon is in the Quadratures: It advances with the greatest* Velocity, *when concurring with the Line of Syzygies; and retrogrades with the greatest Velocity when concurring with the* Line *of Quadratures; the Sum of the Quantities it gains in several Revolutions, exceeding the Quantities it retrogrades during these Revolutions, causes an intire Revolution of the* Line *of Apsides, according to the Order of Signs, in about* 19 *Years.*

XIV. *The* Eccentricity *of the Moon's Orbit varying every* Instant, *is greatest when the* Line *of* Apsides *coincides with that of the Syzygies, and least when the* Line *of Apsides coincides with that of the Quadratures.*

XV. *When the Moon is in the Quadratures, the Nodes of its Orbit are always* stationary; *but commonly retrograde when the Moon is in the Syzygies. In the Interval from one Quadrature to the other, they move the most retrograde when the* Line *of the Nodes concurs with that of the Quadratures; and least, when it concurs with that of the Syzygies.*

XVI. *In every Revolution of the Moon, the Angle of* Inclination *of its Orbit to the Plane of the* Ecliptic, *increases in the Interval from a Syzygy to the next Quadrature; and decreases in the Interval from the Quadrature to the following Syzygy. It is greatest in the Quadrature when the* Line *of the Nodes concurs with that of the Syzygies; and least, in the Syzygy when the* Line *of the Nodes concurs with that of the Quadratures.*

XVII. *The Increase of the* central *Force, in the Quadratures, is to the Force acting upon the Moon's Plane, as the Cube of Radius, is to the triple Sine of the Moon's Distance from the Quadrature, multiplied by the Sine of the Nodes Distance from the Syzygy, and by the Sine of the Inclination of the Moon's Orbit.*

XVIII. *In the Passage from the Syzygy to the following* Quadrature *the Moon's Node moves retrograde, and the Inclination of the Orbit increases.*

XIX. *The Moon's Node moves retrograde, and the Inclination of the Orbit decreases, in the Passage from the* Quadrature *to the following* Syzygy.

XX. In general, *The Moon's Node moves according to the Order of Signs, and is* stationary *only when the Moon is in* Quadrature, *or when without Latitude. In all other* Cases, *it moves retrograde with a Velocity increased in the Proportion to the Moon's* Proximity *to the* Syzygy, *and as its Latitude is greater.*

XXI. *The* Inclination *of the Moon's Orbit, evidently changes four Times in every Revolution,* twice *increasing and* twice *diminishing. It is greatest when the* Line *of Nodes concurs with that of the* Quadratures; *and least when the* Line *of the Nodes coincides with that of the* Syzygies.

XXII. *The Moon's* perturbate *Force, and consequently all its Inequalities, are somewhat* greater *towards the Conjunctions than towards the Oppositions.*

XXIII. *In the* Quadratures, *the Increase of the Moon's Gravity to the* Earth *is always as the Moon's Distance from the* Earth *divided by the* Cube *of the* Earth's *Distance from the Sun.* Or (the Distances being inversely as the apparent Diameters) *as the Cube of the Sun's Diameter seen from the* Earth, *divided by the Moon's Diameter seen from the* Earth.

XXIV. *What holds true in the Moon's Inequalities is likewise applicable to the Satellites of* Jupiter *and* Saturn. But *because of the great Distance of those Planets from the Sun, the Inequalities of their Satellites must be very small; and, are sensible only in these nearest the Planet, on Account of their Proximity.*

XXV. *The* Combination *of the Moon's Gravity towards the* Earth *and the* Sun, *must evidently produce the same* Effects, *whether the* Earth *be supposed to describe an* Ellipsis *about the* Sun, *fixed in one of its Foci, or whether the* Sun *describes an* Ellipsis *about the* Earth, *fixed in one of its* Foci: For *these* Effects *depend upon the Moon's Position and Distance in respect of the* Earth *and* Sun; and therefore whether *the* Earth *or the* Sun *moves, their Situations will be the same to one another; and consequently to the Moon.*

REMARK. To settle the *Moon's Theory*, and construct *Tables* for computing her true *Longitude* and *Latitude*, as seen from the Earth, it will be necessary to determine, by *astronomical Observation*, the Nineteen Elements, following.

1. The Moon's mean *periodical Time*.
2. The mean *periodical Time* of the Moon's *Apogee*.
3. The mean *periodical Time* of the ascending *Node*.
4. An *Epocha* of the Moon's mean Place.
5. An *Epocha* of the mean Place of the *Apogee*.
6. An *Epocha* of the mean Place of the *Nodes*.
   These *Epochas* on the Noon of 31st *December*, 1745, N. S mean Time, were; for the *Moon* $0^s\ 17^\circ\ 33'\ 30''$; for the *Apogee* $0^s\ 8^\circ\ 12'\ 49''$; for the *Node* $11^s\ 27^\circ\ 37'\ 0''$.
7. The *greatest* Equation of the Moon's mean Place.
8. That of the *mean* Place of the Moon's Apogee.
9. That of the mean Place of the Moon's Node.
   These three *Inequalities* serve to *compensate* the Inequalities of the periodical Revolutions, according as the Earth is in its *Perihelion* or *Aphelion*; and are proportional to the Equation of the *Sun's Center*. The *first*, for the *Moon*, is $11'\ 50''$; for the *Apogee* $20'\ 0''$; and for the *Node* $9'\ 30''$.
10. The *greatest* Equation of the Moon's Apogee, which is $12^\circ\ 18'$.
11. The *mean* Eccentricity of the Moon's Orbit; which is 5505 such Parts as the Moon's *mean* Dist. from the Earth contains 100000.
12. The *Relation* between the greatest and least Eccentricities; being as 6677 to 4333.
    By these *Relations* the Equation of the Moon's Center is found in all *Cases*.
13. The Moon's *mean* Variation in *Octants*, being $35'\ 10''$.
14. The *Relation* between the greatest and least Variation; being from $37'\ 25''$ to $33'\ 4''$.
15. The *greatest* second Equat. of Moon's *Node*; being $1^\circ\ 29'\ 40''$.
16. The *mean* Inclin. of the Moon's Orbit; being about $5^\circ\ 8'\ 30''$.
17. The Proportion of the *greatest* to the *least* Inclination being as $5^\circ\ 17'\ 30''$ to $4^\circ\ 59'\ 30''$.
18. The *mean* Parallax of the Moon, being $57'\ 5''$.
19. The *Ratio* of the Parallax to the Moon's Diameter, being as $55'\ 40''$ to $30'$, *nearly*.

Besides which *Elements* there are others giving small Equations. —

☞ *We refer the Reader to our Tables and Comment for the* Explanation *and* Use *of all these* Elements.

MEAN TIME of the FIRST MEAN NEW MOON, in JANUARY, from 1700 to 1800, O. S. With the Places of the Sun's *Mean Anomaly*, Annual *Argument*, and Sun from the *Moon's Node*, correfponding.

Years of Chrift	Firft M. New Moon in *Jan.*	Sun's Mean Anomaly.	Sun from Moon's Apo.	Sun from ☊
	d h m f	s ° ′ ″	s ° ′ ″	s ° ′ ″
1700	9 14 42 44	6 21 43 53	0 0 52 40	4 13 10 32
1	27 12 15 23	7 10 6 5	11 6 29 47	4 21 53 35
2	16 21 4 0	6 29 21 56	9 16 17 52	5 29 56 22
3	6 5 52 37	6 18 37 48	7 26 5 57	6 7 59 9
1704	25 3 25 16	7 6 59 59	7 1 43 3	7 16 42 10
5	13 12 13 53	6 26 15 50	5 11 31 8	7 24 44 57
6	2 21 2 30	6 15 31 4	3 21 19 13	8 2 47 44
7	21 18 35 9	7 3 53 52	2 26 56 19	9 11 30 45
1708	11 3 23 46	6 23 9 43	1 6 44 24	9 19 33 32
9	29 0 56 26	7 11 31 55	0 12 21 30	10 28 16 34
10	18 9 45 2	7 0 47 46	10 22 9 35	11 6 19 21
11	7 18 33 39	6 20 3 38	9 1 57 40	11 14 22 9
1712	26 6 6 18	7 8 25 48	8 7 34 46	0 23 5 10
13	15 0 54 55	6 27 41 40	6 17 22 51	1 1 7 56
14	4 9 43 32	6 16 57 30	4 27 10 56	1 9 10 44
15	23 7 16 11	7 5 19 43	4 2 48 2	2 17 53 44
1716	12 16 4 48	6 24 35 33	2 12 36 7	2 25 56 32
17	1 0 53 30	6 13 51 26	0 22 24 12	3 3 59 20
18	19 22 26 4	7 2 13 37	11 28 1 18	4 12 42 20
19	9 7 14 41	6 21 29 28	10 7 49 23	4 20 45 8
1720	28 4 47 20	7 9 51 39	9 13 26 29	5 29 28 9
21	16 13 35 57	6 29 7 31	7 23 14 34	6 7 30 57
22	5 22 24 33	6 18 23 22	6 3 2 39	6 15 33 43
23	24 19 57 13	7 6 45 33	5 8 39 45	7 24 16 44
1724	14 4 45 50	6 26 1 24	3 18 27 50	8 2 19 31
25	2 13 34 26	6 15 7 15	1 28 15 55	8 10 22 20
26	21 11 7 6	7 3 39 26	1 3 53 1	9 19 5 20
27	10 19 55 43	6 22 55 19	11 13 41 6	9 27 8 7
1728	0 4 44 19	6 12 11 10	9 23 29 12	10 5 10 54
29	18 2 16 59	7 0 33 21	8 29 6 17	11 13 53 56
30	7 11 5 35	6 19 49 21	7 8 54 22	11 21 56 42
31	26 8 38 15	7 8 11 23	6 14 31 28	1 0 39 44
1732	15 17 26 52	6 27 27 13	4 24 19 33	1 8 42 31
33	4 2 15 28	6 16 43 5	3 4 7 38	1 16 45 19
34	22 23 48 8	7 5 5 17	2 9 44 44	1 25 28 20
35	12 8 36 44	6 24 21 8	0 19 32 49	3 3 31 7
1736	1 17 25 21	6 13 36 59	10 29 20 54	3 11 33 54
37	19 14 58 1	7 1 59 10	10 4 58 0	4 20 16 56
38	8 23 46 37	6 21 15 1	8 14 46 5	4 28 19 43
39	27 21 19 17	7 9 37 12	7 20 23 11	6 7 2 44
1740	17 6 7 54	6 28 53 4	6 0 11 16	6 15 5 31
41	5 14 56 30	6 18 8 56	4 9 59 22	6 23 8 19
42	24 12 29 10	7 6 31 7	3 15 36 27	8 1 51 20
43	13 21 17 46	6 25 46 58	1 25 24 32	8 9 54 7
1744	3 6 6 23	6 15 2 49	0 5 12 37	8 17 56 55
45	21 3 39 3	7 3 25 1	11 10 49 43	9 26 39 56
46	10 12 27 39	6 22 40 52	9 20 37 48	10 4 42 43
47	29 10 0 19	7 11 3 3	8 26 14 54	11 13 25 44
1748	18 18 48 55	7 0 18 54	7 6 2 59	11 21 28 31
49	7 3 37 32	6 19 34 45	5 15 51 4	11 29 31 18
50	26 1 10 12	7 7 56 56	4 21 28 10	1 8 14 19
51	15 9 58 48	6 27 12 48	3 1 16 15	1 16 17 6

Years of Chrift	Firft M. New Moon in *Jan.*	Sun's Mean Anomaly.	Sun from Moon's Apo.	Sun from ☊
	d h m f	s ° ′ ″	s ° ′ ″	s ° ′ ″
1752	4 18 47 25	6 16 28 39	1 11 4 20	1 24 19 53
53	22 16 20 4	7 4 50 50	0 16 41 26	3 3 2 55
54	12 1 8 41	6 24 6 41	10 26 29 31	3 11 5 42
55	1 9 57 17	6 13 22 32	9 6 17 36	3 19 8 29
1756	20 7 29 57	7 1 44 44	8 11 54 42	4 27 51 30
57	8 16 18 34	6 21 0 36	6 21 42 48	3 5 54 18
58	27 13 51 14	7 9 22 47	5 27 19 54	6 14 37 19
59	16 22 39 50	6 28 38 38	4 7 7 59	6 22 40 6
1760	6 7 28 27	6 17 54 29	2 16 56 4	7 0 42 53
61	24 5 1 6	7 6 16 40	1 22 33 10	8 9 25 54
62	13 13 49 43	6 25 32 32	0 2 21 14	8 17 28 41
63	2 22 38 20	6 14 48 23	10 12 9 19	8 25 31 28
1764	21 20 10 59	7 3 10 34	9 17 46 25	10 4 14 29
65	10 4 59 36	6 22 26 26	7 27 34 31	10 12 17 17
66	29 2 34 15	7 10 48 37	7 3 11 37	11 21 0 19
67	18 11 20 52	7 0 4 28	5 12 59 42	11 29 3 6
1768	7 20 9 29	6 19 20 20	3 22 47 47	0 7 5 53
69	25 17 42 8	7 7 42 30	2 28 24 53	1 15 48 54
70	15 2 30 45	6 26 58 21	1 8 12 58	1 23 51 41
71	4 11 19 21	6 16 14 12	11 18 1 3	2 1 54 28
1772	23 8 52 1	7 4 36 23	10 23 38 9	3 10 37 2[illegible]
73	11 17 40 38	6 23 52 15	9 3 26 14	3 18 40 17
74	1 2 29 14	6 13 8 8	7 13 14 19	3 26 43 5
75	20 0 1 54	7 1 30 19	6 18 51 25	5 5 26 6
1776	9 8 50 31	6 20 46 10	4 28 39 30	5 13 28 53
77	27 6 23 10	7 9 8 20	4 4 16 36	6 22 11 54
78	16 15 11 47	6 28 24 11	2 14 4 41	7 0 14 41
79	6 0 0 23	6 17 40 2	0 23 52 46	7 8 17 28
1780	24 21 33 3	7 6 2 14	11 29 29 52	8 17 0 29
81	13 6 21 40	6 25 18 6	10 9 17 57	8 25 3 16
82	2 15 10 16	6 14 33 56	8 19 6 1	9 3 6 3
83	21 12 42 56	7 2 56 7	7 24 43 7	10 11 49 4
1784	10 21 31 32	6 22 11 58	6 4 31 12	10 19 51 51
85	28 19 4 12	7 10 34 10	5 10 8 18	11 28 34 53
86	18 3 52 49	6 29 50 2	3 19 56 23	0 6 37 40
87	7 12 41 25	6 19 5 53	1 29 44 29	0 14 40 27
1788	26 10 14 5	7 7 28 4	1 5 21 34	1 23 23 29
89	14 19 2 42	6 26 43 55	11 15 9 40	2 1 26 16
90	4 3 51 18	6 15 59 46	9 24 57 45	2 9 29 3
91	23 1 23 58	7 4 21 57	9 0 34 50	3 18 12 5
1792	12 10 12 34	6 23 37 40	7 10 22 56	3 26 14 52
93	0 19 1 11	6 12 53 41	5 20 11 1	4 4 17 40
94	19 16 33 51	7 1 15 52	4 25 48 6	5 13 0 41
95	9 1 22 27	6 20 31 43	3 5 36 12	5 21 3 28
1796	27 22 55 7	7 8 53 54	2 11 13 17	6 29 46 20
97	16 7 43 43	6 26 9 44	0 21 1 23	7 7 49 16
98	5 16 32 20	6 17 25 36	11 0 49 28	7 15 52 3
99	24 14 5 0	7 5 47 47	10 6 26 34	8 24 35 5
1800	13 22 53 36	6 25 3 38	8 16 14 39	9 2 37 52

☞ For Conveniency of Computation, the Computer muft reduce the New and Full Moons of the Old, to the Days of New Style, by adding the Number of Days Difference of Style.

Number of DAYS in the MONTHLY REVOLUTIONS of the MOON with the SUN, from *January*. With the Motion of the Sun's Mean Anomaly, Annual Argument, and Sun from Moon's *Node*, correfponding.

No. Ds.	Ms.	+ Days from January ☽.	Motion Sun's M. Anomaly.	Mo. Sun from Moon's Apog.	Motion Sun from ☊
		d h m s	s ° ′ ″	s ° ′ ″	s ° ′ ″
29	Jan	29 12 44 3	0 29 6 19	0 25 49 0	1 0 40 14
59	Feb	28 1 28 6	1 28 12 39	1 21 38 1	2 1 20 28
88	Ma	29 14 12 9	2 27 18 58	2 17 27 1	3 2 0 42
118	Apr	28 2 56 12	3 26 25 17	3 13 16 2	4 2 40 56
147	M.	27 15 40 15	4 25 31 37	4 9 5 2	5 3 21 10
177	Jun	26 4 24 18	5 24 37 56	5 4 54 3	6 4 1 24

In Leap-Year, take out one Day lefs, after *February*, than the tabular Number; but take out the fame Motion.

No. Ds.	Ms.	+ Days from January ☽.	Motion Sun's M. Anomaly.	Mo. Sun from Moon's Apog.	Motion Sun from ☊
		d h m s	s ° ′ ″	s ° ′ ″	s ° ′ ″
206	Jul.	25 17 8 21	6 23 44 15	6 0 43 3	7 4 41 38
236	Au.	24 5 52 24	7 22 50 34	6 26 32 3	8 5 21 51
265	Sep	22 18 36 27	8 21 56 53	7 22 21 4	9 6 2 5
295	Oct	22 7 20 30	9 21 3 13	8 18 10 4	10 6 42 19
324	No.	20 20 4 34	10 20 9 32	9 13 59 5	11 7 22 33
354	Dec	20 8 48 37	11 19 15 51	10 9 48 5	0 8 2 47
Half Revol.		14 18 22 2	0 14 33 10	0 12 54 30	0 15 20 7

N. B. The above is the *only Table* wherein a Day's Motion, at the Year's Beginning is not advanced, in *Leap-Years*; being conftructed according to the *Old Method* of Computation requiring it to be fo.

☞ Subtracting for Half a Revolution from the Time and Places in *January* O. S. will give the Time and Places for the preceding Full Moon; *i. e.* When the Days on which a New Moon happens exceed 15. Or the above Table is eafily reduced to New Style. But the Examination of *antient Eclipfes* is according to the above Table by Old Style.

REVOLUTIONS of the MOON to the SUN, next after *Julian* CENTURIES completed.

Synodic Months.	Julian Centuries.	Time of 1st New Moon after Jul. Cents completed.				Sun's Mean Anomaly.				Sun from Moon's Apogee.				Sun from Node.			
		D	H	M	S	s	°	'	"	s	°	'	"	s	°	'	"
1237	100	4	8	10	52	0	3	19	44	8	15	21	59	4	19	27	17
2474	200	8	16	21	45	0	6	39	29	5	0	43	58	9	8	54	35
3711	300	13	0	32	37	0	9	59	13	1	16	5	57	1	28	21	52
4948	400	17	8	43	29	0	13	18	58	10	1	27	56	6	17	49	10
6185	500	21	16	54	22	0	16	38	42	6	16	49	54	11	7	16	27
7422	600	26	1	5	14	0	19	58	27	3	2	11	53	3	26	43	45
8658	700	0	20	32	3	11	24	11	52	10	21	44	52	7	15	30	48
9895	800	5	4	42	56	11	27	31	37	7	7	6	51	0	4	58	6
11132	900	9	12	53	48	0	0	51	21	3	22	28	50	4	24	25	23
12369	1000	13	21	4	40	0	4	11	6	0	7	50	49	9	13	52	40
13606	1100	18	5	15	33	0	7	30	50	8	23	12	48	2	3	19	58
14843	1200	22	13	26	25	0	10	50	35	5	8	34	47	6	22	47	15
16080	1300	26	21	37	17	0	14	10	19	1	23	56	46	11	12	14	33
17316	1400	1	17	4	6	11	18	23	44	9	13	29	44	3	1	1	36
18553	1500	6	1	14	59	11	21	43	29	5	28	51	43	7	20	28	54
19790	1600	10	9	25	51	11	25	3	13	2	14	13	42	0	9	56	11
21027	1700	14	17	36	44	11	28	22	58	10	29	35	41	4	29	23	28
22264	1800	19	1	47	36	0	1	42	42	7	14	57	40	9	18	50	46
23501	1900	23	9	58	28	0	5	2	27	4	0	19	39	2	8	18	3
24738	2000	27	18	9	21	0	8	22	11	0	15	41	38	6	27	45	21
25974	2100	2	13	36	10	11	12	35	36	8	5	14	35	10	16	32	24
27211	2200	6	21	47	2	11	15	55	20	4	20	36	34	3	5	59	41
28448	2300	11	5	57	54	11	19	15	5	1	5	58	33	7	25	26	59
29685	2400	15	14	8	47	11	22	34	49	9	21	20	32	0	14	54	16
30922	2500	19	22	19	39	11	25	54	34	6	6	42	31	5	4	21	34
32159	2600	24	6	30	31	11	29	14	18	2	22	4	29	9	23	48	51
33396	2700	28	14	41	24	0	2	34	3	11	7	26	28	2	13	16	9
34632	2800	3	10	8	13	11	6	47	28	6	26	59	27	6	2	3	12
35869	2900	7	18	19	5	11	10	7	12	3	12	21	26	10	21	30	29
37106	3000	12	2	29	57	11	13	26	57	11	27	43	25	3	10	57	47
38343	3100	16	10	40	50	11	16	46	41	8	13	5	24	8	0	25	4
39580	3200	20	18	51	42	11	20	6	26	4	28	27	23	9	19	52	22

ECLIPSE-REVOLUTIONS and other PERIODS of the MOON to the SUN.

Synodic Months.	Periods in Julian Years and Parts.					Sun's Mean Anomaly.				Sun from Moon's Apogee.				Sun from Node.			
	Julian Years.	D	H	M	S	s	°	'	"	s	°	'	"	s	°	'	"
Pl. Pe. 111	8	355	21	29	38	11	20	41	42	11	15	39	48	5	14	25	47
1. 223	18	11	7	43	20	0	10	29	42	11	27	8	37	11	29	31	48
235	19	0	16	31	56	11	29	45	33	10	6	56	42	0	7	34	35
251	20	107	4	16	45	3	15	26	42	0	0	0	49	4	18	18	18
270	21	303	6	13	43	9	28	16	49	4	10	31	58	0	1	2	42
364	29	157	3	14	30	5	4	21	3	1	7	18	39	0	4	4	32
2. 446	36	21	15	26	40	0	20	59	24	11	24	17	14	11	29	3	35
534	43	64	8	3	8	2	2	15	42	3	15	9	53	5	28	4	2
587	47	168	10	57	50	5	14	50	45	1	4	27	15	0	3	36	19
3. 669	54	32	23	10	0	1	1	29	6	11	21	25	51	11	28	35	23
767	62	4	23	6	59	0	3	48	38	0	1	28	34	4	4	18	8
810	65	178	18	41	10	5	25	20	27	0	1	35	53	0	3	8	7
4. 892	72	43	6	53	20	1	11	58	48	11	18	34	28	11	28	7	10
980	79	85	23	29	49	2	23	15	7	3	10	27	8	5	27	7	36
5. 1115	90	54	14	36	40	1	22	28	30	11	15	43	5	11	27	38	58
1203	97	96	7	13	9	3	3	45	50	3	7	35	43	5	26	39	24
6. 1338	108	65	22	20	0	2	2	58	12	11	12	51	42	11	27	10	45
2148	173	243	17	1	10	7	28	18	40	0	14	27	36	0	0	18	52
2301	186	13	21	20	57	0	11	25	52	0	4	25	43	0	12	54	25
2371	191	255	0	44	31	8	8	48	22	0	11	36	13	11	29	50	39
2641	213	192	6	58	14	6	7	15	11	4	22	8	10	0	0	53	22
2817	227	276	16	11	11	8	29	47	46	0	5	53	28	11	28	54	14
3040	245	286	23	54	31	9	10	17	28	0	3	2	5	11	28	26	2
3621	292	277	6	28	3	9	0	30	17	8	2	35	17	5	28	0	58
3709	299	319	23	4	31	10	11	46	35	11	24	27	56	11	27	1	24
4267	344	361	0	44	53	11	22	34	0	0	0	13	59	6	11	11	0
4601	371	363	5	57	51	11	23	45	23	11	13	2	24	11	25	8	34
5059	409	8	6	13	8	0	4	0	46	9	17	7	44	0	2	14	56
5458	441	102	23	9	25	3	7	2	57	4	28	1	38	11	29	47	37
6444	521	0	3	3	31	11	24	56	0	1	13	22	46	0	0	56	36
6890	557	21	18	30	12	0	15	55	24	1	7	40	2	0	0	0	11
15928	1287	287	6	1	34	9	0	9	40	2	29	47	40	0	0	19	14
22325	1804	359	10	34	42	11	7	8	19	11	29	47	6	11	29	44	56

			Sig.	Sig.	Sig.
N. B. 1	0	29d,530590852 ……	,9701786292 ……	,8605595917 ……	1,02235124
716	57	324d.21h.40m.23s. ……	10s.19°.26'.13" ……	4s.4°.49'.12" ……	0s.00.6'.16"

&c. And other Periods are also had by compounding the *above-Periods*.

Plinian

Plinian PERIOD of *Solar* ECLIPSES. According to *New Stile.*

Years of Chr. N. S.	Mid. Ecl. of ☉, at Lond. apt. Time. M D H M	Sun's M. Anom. s ° ′	Sun à ☽'s Ap. s ° ′	Lat. ☽ fr. Sun. ′ ″	N. or S. asc. or desc.
1701	Febru. 7 11 6	7 10 3	11 7 30	35 20	N.A.
	August 3 21 30	1 4 56	4 10 40	26 22	S.D.
1702	Janua. 27 13 42	6 29 4	9 16 50	3 35	S.A.
	July 24 9 39	0 24 20	2 20 50	18 14	N D.
1703	Janua. 16 23 27	6 18 22	7 26 23	43 50	S.A.
	July 13 14 36½	0 13 27	1 0 47	61 0	N.D.
	Decem. 8 3 44	5 8 52	5 9 33	79 13	N.A.
1704	Janua. 6 14 15	6 7 53	6 6 6	84 20	S.A.
	June 2 1 7	11 3 13	10 15 30	51 33	S.D.
	Nov. 26 17 38	4 28 20	3 19 16	38 37	N.A.
1705	May 22 7 55	10 22 23	8 25 29	8 26	S.D.
	Nov. 16 1 20	4 17 33	1 28 48	1 29	S.A.
1706	May 11 21 34	10 11 51	7 5 40	36 12	N.D.
	Nov. 5 2 19	4 6 30	2 8 6	40 21	S.A.
1707	May 1 14 19	10 1 27	5 16 30	80 24	N.D.
	Sept. 25 11 4	2 26 12	9 20 43	81 33	N.A.
	Oct. 25 2 16	3 25 25	10 17 26	78 36	S.A.
1708	Mar. 21 18 53	8 21 57	3 0 30	33 21	S.D.
	Sept. 13 21 0	2 15 30	8 1 17	39 43	N.A.
1709	Mar. 11 0 17	8 11 5	1 10 5	7 26	N.D.
	Sept. 3 12 36	2 5 3	6 11 26	4 30	S.A.
1710	Feb. 28 0 14	7 29 59	11 19 27	46 31	N.D.
	August 24 5 16	1 24 38	4 21 40	49 15	S.A.
1711	Feb. 17 1 38	7 18 56	9 28 48	84 45	N.D.
	July 15 7 20	0 15 2	2 6 45	61 10	N.A.
1712	Janua. 7 22 1	6 9 6	7 11 49	38 58	S.D.
	July 3 10 34½	0 4 5	0 16 39	18 43	N.A.
	Decem. 27 13 27	5 28 39	5 21 34	2 35	N.D.
1713	June 22 11 18	11 23 1	10 26 27	23 40	S.A.
	Decem. 17 4 2	5 18 9	4 1 17	43 49	N.D.
1714	June 11 16 44	11 12 8	9 6 26	66 25	S.A.
	Decem. 6 13 28	5 7 26	2 10 49	83 8	N.D.
1715	May 2 21 35½	10 2 39	6 21 36	43 25	N A.
	Oct. 26 20 55	3 27 5	11 23 31	42 37	S.D.
1716	April 21 14 [illegible]	9 22 15	5 1 49	1 19	S.A.
	Oct. 14 22 6	3 16 2	10 2 56	3 2	S.D.
1717	April 11 4 35	9 11 44	3 11 54	45 5	S.A.
	Oct. 4 6 21	3 5 16	8 12 40	38 30	N.D.
1718	Mar. 1 19 30	8 1 41	0 25 34	74 30	N.A.
	Mar. 31 12 5	9 0 57	1 21 42	86 7	S.A.
	Sept. 23 20 38	2 24 45	6 22 41	81 0	N D.

Plinian PERIOD of *Lunar* ECLIPSES. According to *New Stile.*

Years of Chr. N. S.	Mid. Ecl. of ☽, at Lond. apt. Time. M D H M	Sun's M. Anom. s ° ′	Sun à ☽'s Ap. s ° ′	Lat. ☽ fr. Sun. ′ ″	N. or S. asc. or desc.
1701	Febru. 22 11 29	7 24 51	11 20 54	47 55	N.D.
	August 18 1 32	1 18 54	4 22 45	48 24	S.A.
1703	Janua. 2 18 59	6 4 23	7 13 35	35 43	S.D.
	June 28 13 10	11 28 36	0 18 1	17 43	N.A.
	Decem. 22 18 30	5 23 16	5 22 44	2 1	N.D.
1704	June 17 6 24	11 18 12	10 28 25	28 14	S.A.
	Decem. 10 19 10	5 12 12	4 1 56	40 3	N.D.
1706	April 27 13 33	9 27 44	6 23 22	40 10	N.A.
	Oct. 21 6 56	3 21 54	11 24 58	41 17	S D.
1707	April 16 13 38	9 16 38	5 2 59	0 52	S.A.
	Oct. 10 22 25	3 11 27	10 4 56	1 41	N D.
1708	April 4 17 38	9 5 42	3 12 40	42 13	S.A.
	Sept. 29 8 59	3 0 47	8 14 46	43 52	N.D.
1710	Feb. 13 10 49½	7 15 38	11 6 28	34 0	N.A.
	August 8 22 0	1 9 33	4 8 34	31 42	S D.
1711	Feb. 3 0 32½	7 5 6	9 16 14	7 36	S.A.
	July 29 5 52	0 28 47	2 18 35	11 28	N.D.
1712	Janua. 23 7 47	6 24 18	7 25 43	47 21	[illegible]
	July 17 20 10½	3 18 16	0 28 52	36 40	N.D.
1713	June 8 6 30	11 9 1	10 14 2	50 45	S.D.
	Decem. 1 15 16	5 2 50	3 17 18	43 10	N.A.
1714	May 28 19 5	10 28 20	8 24 37	6 14	S.D.
	Nov. 21 1 4	4 22 9	1 26 52	2 42	N.A.
1715	May 18 0 31	10 17 35	7 4 32	36 41	N.D.
	Nov. 10 16 0	4 11 40	0 6 41	39 13	S.A.
1717	Mar. 26 15 15	8 26 24	2 28 21	37 57	S.D.
	Sept. 20 5 56	2 21 27	8 0 26	37 25	N A.
1718	Mar. 16 3 58	8 15 50	1 8 15	3 41	N.D.
	Sept. 9 7 52	2 10 26	6 10 4	3 39	S.A.

Besides these 29 *lunar* and 41 *solar* Eclipses in this *Plinian* Period, of $18^{y}\ 11^{d}\ 7^{h}\ 43^{m}\ 20^{s}$, there were 5 *solar* Ones of no Use, *viz* in *Mar.* 1707, *Jan.* 1711, *Oct.* 1714, *Aug.* 1718, O. S. arising but to few Digits near the S. Pole. The 5th was on *May* 13, 1714, N. S. but 1 Digit in Quantity, near the N. Pole. So that the *New Moon* in *May*, 1732, was not eclipsed. But as, by the *shifting* of ☽'s *Node*, the Earth and Moon's Shadows are also shifted from falling on each other of those Bodies, so as to fall into the *Expanse*, the *Tab.* of Eclipse Periods, or No. of synodic Revolutions of ☽ to the ☉ (*when the Sun comes near the Moon's Node*) in P. 386, serves to shew when *Eclipses* will happen again, after a given No of Years, whether in *Plinian* or other *Periods.* For each *Plinian* Period there is an Equation of *Time-Table*, and Diff. Moon's Lat. below.

EQUATION of TIME and of MOON's Latitude, N. or S. ascending or descending, after one *Plinian* Period.

Argument. Sun's Mean Anomaly.												*Argument.* Sun from Moon's Apogee, 1 eqd.							
☉'s M. An.	— Time.	Dif. Moon's Lat.	☉'s M. An.	+ Time.	Dif. Moon's Lat.	☉'s M. An.	+ Time.	Dif. Moon's Lat.	☉ M An.	— Time.	Dif. Moon's Lat.	Sun à ☽ Ap.	— Time.	Sun à ☽ Ap.	+ Time.	Sun à ☽ Ap.	+ Time.	Sun à ☽ Ap.	+ Time.
s °	m s	′ ″	s °	m s	′ ″	s °	m s	′ ″	s °	m s	′ ″	s °	m s	s °	m s	s °	m s	s °	m s
0 0	45 2	4 27	3 5	7 19	2 7	6 5	46 19	0 24	9 5	9 7	2 50	0 0	29 7	3 5	3 42	6 5	25 3	9 5	0 22
5	44 30	4 26										5	29 5						
10	43 44	4 24	10	11 20	1 56	10	45 22	0 26	10	12 58	3 0	10	28 44	10	5 59	10	24 50	10	— 2 0
15	42 36	4 21	15	15 13	1 46	15	44 2	0 29	15	16 42	3 10	15	28 12	15	8 6	15	24 30	15	4 31
20	41 9	4 16	20	19 4	1 36	20	42 27	0 34	20	20 18	3 20	20	27 18	20	10 10	20	24 7	20	6 57
25	39 25	4 11	25	22 46	1 26	25	40 26	0 39	25	23 46	3 29	25	26 12	25	12 8	25	23 30	25	9 23
1 0	37 23	4 6	4 0	26 17	1 16	7 0	37 59	0 46	10 0	26 58	3 38	1 0	24 47	4 0	13 59	7 0	22 41	10 0	11 45
5	35 4	4 0	5	29 39	1 7	5	35 22	0 53	5	29 57	3 46	5	23 19	5	15 44	5	21 42	5	14 4
10	32 30	3 53	10	32 47	0 59	10	32 28	1 0	10	32 48	3 54	10	21 38	10	17 18	10	20 38	10	16 22
15	29 41	3 45	15	35 39	0 52	15	29 18	1 8	15	35 21	4 0	15	19 40	15	18 40	15	19 27	15	18 33
20	26 37	3 37	20	38 18	0 45	20	25 55	1 17	20	37 38	4 6	20	17 36	20	20 0	20	18 10	20	20 30
25	23 21	3 28	25	40 40	0 39	25	22 24	1 26	25	39 35	4 12	25	15 25	25	21 10	25	16 35	25	22 21
2 0	19 55	3 19	5 0	42 37	0 34	8 0	18 40	1 36	11 0	41 17	4 17	2 0	13 11	5 0	22 11	8 0	15 0	11 0	23 50
5	16 20	3 9	5	44 11	0 30	5	14 50	1 46	5	42 42	4 21	5	10 48	5	22 57	5	13 15	5	25 29
10	12 32	2 59	10	45 30	0 26	10	10 53	1 57	10	43 50	4 24	10	8 21	10	23 41	10	11 21	10	26 45
15	8 43	2 49	15	46 25	0 24	15	6 55	2 7	15	44 35	4 26	15	5 53	15	24 19	15	9 19	15	27 36
20	4 48	2 38	20	46 58	0 23	20	2 51	2 18	20	45 2	4 27	20	3 25	20	24 39	20	7 12	20	28 27
25	0 45	2 28	25	47 7	0 23	25	— 1 11	2 29	25	45 13	4 28	25	1 0	25	24 59	25	5 0	25	28 54
3 0	+ 3 18	2 17	6 0	46 54	0 23	9 0	5 13	2 40	12 0	45 2	4 27	3 0	+ 1 20	6 0	25 5	9 0	2 42	12 0	29 7

N. B. The mean Dist. of Sun à ☊ in a *Plinian* Period being [Decim.] $11^{s},984329$ wanting [Decim.] ,47013″, of a Degree of a Revolution If that Decimal be multiplied into the Number of *Plinian* Periods since any Eclipse, the Product will be the Degrees of Sun's Dist. à ☊, less than the Dist. when the Eclipse happened. Which Dist. taken from the Sun's 1st Dist. à ☊, will shew the Sun's present Dist. à ☊. And if within 18 or 12° (the Limits of solar and lunar Eclipses, respectively) an Eclipse of one of those *Luminaries* will respectively happen again; otherwise not.

RADICAL Mean PLACES and MOTIONS of the MOON from the SUN, *&c.* for determining the Mean TIME of the *mean*, and then the true NEW and FULL MOONS, with (or without) Acceleration of Mean Motion. According to Old Style.

Years of Christ.	☽ à ☉	☉'s M. An.	☉ à ☽'s Ap.	☉ à ☊
	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″
1652	0 6 48 7	6 13 41 55	4 26 11 38	9 5 27 23
53	4 16 25 30	6 13 26 34	3 15 17 28	0 24 32 46
54	8 26 2 54	6 13 11 14	2 4 23 18	10 13 38 16
55	1 5 40 17	6 12 55 54	0 13 29 7	11 2 43 33
1656	5 27 29 7	6 13 39 38	11 13 27 24	11 22 51 15
57	10 7 6 30	6 13 24 18	10 2 33 14	0 11 56 38
58	2 16 43 53	6 13 8 57	8 21 39 4	1 1 2 2
59	6 26 21 17	6 12 53 37	7 10 44 53	1 20 7 25
1660	11 18 10 6	6 13 37 22	6 0 43 11	2 10 15 8
61	3 27 47 29	6 13 22 2	4 19 49 1	0 29 20 31
62	8 7 24 53	6 13 6 41	3 8 54 51	3 18 25 55
63	0 17 2 17	6 12 51 21	1 28 0 40	4 7 31 18
1664	5 8 51 6	6 13 35 5	0 17 58 57	4 27 39 0
65	9 18 28 29	6 13 19 45	0 7 4 47	5 16 44 23
66	1 28 5 52	6 13 4 24	9 26 10 37	5 35 49 47
67	6 7 43 16	6 12 49 4	8 15 16 26	6 24 55 10
1668	10 29 32 6	6 13 32 48	7 5 14 43	7 15 2 52
69	3 9 9 29	6 13 17 28	5 24 20 33	8 4 8 15
70	7 18 46 52	6 13 2 7	4 13 26 23	8 23 13 39
71	11 28 24 16	6 12 46 47	3 2 32 12	9 12 19 2
1672	4 20 13 6	6 13 30 31	1 22 30 29	10 2 26 44
73	8 29 50 29	6 13 15 11	0 11 36 19	10 21 32 7
74	1 9 27 52	6 12 59 50	11 0 42 9	11 10 37 31
75	5 19 5 16	6 12 44 30	9 19 47 58	11 29 42 54
1676	10 10 54 5	6 13 28 15	8 9 46 16	0 19 50 37
77	2 20 31 28	6 13 12 55	6 28 52 6	1 8 56 0
78	7 0 8 51	6 12 57 34	5 17 57 56	1 28 1 24
79	11 9 46 15	6 12 42 14	4 7 3 45	2 17 6 47
1680	4 1 35 5	6 13 25 58	2 7 2 2	3 7 14 29
81	8 11 12 28	6 13 10 38	0 26 7 52	3 26 19 52
82	0 20 49 51	6 12 55 17	11 15 13 42	4 15 25 16
83	5 0 27 15	6 12 39 57	10 4 19 31	5 4 30 39
1684	9 22 16 4	6 13 23 42	8 24 17 49	5 24 38 22
85	2 1 53 27	6 13 8 22	7 13 23 39	6 13 43 45
86	6 11 30 50	6 12 53 1	6 2 29 29	7 2 49 9
87	10 21 8 14	6 12 37 41	4 21 35 18	7 21 54 32
1688	3 12 57 4	6 13 21 25	3 11 33 35	8 12 2 14
89	7 22 34 27	6 13 6 5	2 0 39 25	9 1 7 37
90	0 2 11 50	6 12 50 44	0 19 45 15	9 20 13 1
91	4 11 49 14	6 12 35 24	11 8 51 4	10 9 18 24
1692	9 3 38 4	6 13 19 8	9 28 49 21	10 29 26 6
93	1 13 15 27	6 13 3 48	8 17 55 11	11 18 31 29
94	5 22 52 50	6 12 48 27	7 7 1 2	0 7 36 53
95	10 2 30 14	6 12 33 7	5 26 6 50	0 26 42 16
1696	2 24 19 4	6 13 16 51	4 16 5 7	1 16 49 58
97	7 3 56 27	6 13 1 31	3 5 10 57	2 5 55 21
98	11 13 33 50	6 12 46 10	1 24 16 47	2 55 0 45
99	3 23 11 14	6 12 30 50	0 13 22 36	3 14 6 8
1700	8 15 0 4	6 13 14 34	11 23 20 53	4 4 13 50
1	0 24 37 27	6 12 59 14	10 12 26 43	4 23 19 13
2	5 4 14 50	6 12 43 53	9 1 32 33	5 12 24 37
3	9 13 52 14	6 12 28 33	7 20 38 22	6 1 30 0

Years of Christ.	☽ à ☉	☉'s M. An.	☉ à ☽'s Ap.	☉ à ☊
	s ° ″ ′	s ° ′ ″	s ° ′ ″	s ° ′ ″
1704	2 5 41 4	6 13 12 17	6 10 36 39	6 21 37 42
5	6 15 18 27	6 12 56 57	4 19 42 29	7 10 43 5
6	10 24 55 50	6 12 41 36	8 18 48 19	7 29 48 29
7	8 4 33 14	6 12 26 15	2 7 54 8	8 18 53 52
1708	7 26 22 3	6 13 10 1	0 27 52 26	9 9 1 35
9	0 5 59 26	6 12 54 41	11 16 58 16	9 28 6 58
10	4 15 36 49	6 12 39 20	10 6 4 6	10 17 12 22
11	8 25 14 13	6 12 24 0	8 25 9 55	11 6 17 45
1712	1 17 3 3	6 13 7 44	7 15 8 12	11 26 25 27
13	5 26 40 26	6 12 52 24	6 4 14 2	0 15 26 50
14	10 6 17 49	6 12 57 3	4 23 19 52	1 4 36 14
15	2 15 55 13	6 12 21 43	3 12 25 41	1 23 41 37
1716	7 7 44 3	6 13 5 27	2 2 23 58	2 13 49 19
17	11 17 21 26	6 12 50 7	0 21 29 48	3 2 54 42
18	3 26 58 49	6 12 34 46	11 10 35 38	3 22 0 6
19	8 6 36 13	6 12 19 26	9 29 41 27	4 11 5 29
1720	0 28 25 3	6 13 3 10	8 19 39 44	5 1 13 11
21	5 8 2 26	6 12 47 50	7 8 45 34	5 20 18 34
22	9 17 39 49	6 12 32 29	5 27 51 24	6 9 23 56
23	1 27 17 13	6 12 17 9	4 16 57 13	6 28 29 21
1724	6 19 6 2	6 13 0 54	3 6 55 31	7 18 37 4
25	10 28 43 25	6 12 45 34	1 26 1 21	8 7 42 27
26	3 8 20 48	6 12 30 13	0 5 7 11	8 26 47 51
27	7 17 58 12	6 12 14 53	11 4 13 0	9 15 53 14
1728	0 9 47 2	6 12 58 37	9 24 11 17	10 6 0 56
29	4 19 24 25	6 12 43 17	8 13 17 7	10 25 6 19
30	8 29 1 48	6 12 27 56	7 2 22 57	11 14 11 43
31	4 21 48 49	6 12 12 36	5 21 28 46	0 3 17 6
1732	6 0 28 2	6 12 56 20	4 11 27 3	0 23 24 48
33	10 10 5 25	6 12 41 0	3 0 32 53	1 12 30 11
34	2 19 42 48	6 12 25 39	1 19 38 43	2 1 35 35
35	6 29 20 12	6 12 10 19	0 8 44 32	2 20 46 58
1736	11 21 9 1	6 12 54 4	10 28 42 50	3 10 48 41
37	4 0 46 24	6 12 38 44	9 17 48 40	3 29 54 4
38	8 10 23 47	6 12 23 23	8 6 54 30	4 18 59 28
39	0 20 1 11	6 12 8 3	6 26 0 19	5 8 4 51
1340	5 11 50 1	6 12 51 47	5 15 58 36	5 28 12 33
41	9 21 27 24	6 12 36 27	4 5 4 26	6 17 17 50
42	[illegible] 1 4 47	6 12 21 6	2 24 10 16	7 6 23 20
43	6 10 42 11	6 12 5 46	1 13 16 5	7 25 28 43
1744	11 2 31 1	6 12 49 30	0 3 14 22	8 15 36 25
45	3 12 8 24	6 12 34 10	10 22 20 12	9 4 41 48
46	7 25 45 47	6 12 18 49	9 11 26 2	9 23 47 12
47	0 1 23 11	6 12 3 29	8 0 31 51	10 12 52 35
1748	4 23 12 1	6 12 47 13	6 20 30 8	11 3 0 17
49	9 2 49 24	6 12 31 53	5 9 35 58	11 22 5 40
50	1 12 26 47	6 12 16 32	3 28 41 48	0 11 11 4
51	5 22 4 11	6 12 1 12	2 17 47 37	1 0 16 27
1752	10 13 53 0	6 12 44 57	1 7 45 55	1 20 24 10

For Conveniency of Computation, the Computer must reduce the New and Full Moons of the Old to the Day of New Style, by adding the Number of Days Difference of the Style.

Mean MOTION of the MOON from the SUN, *&c.* for *Julian* CENTURIES.

Julian Cent.	Mot. ☽ à ☉	Mot. ☉ An.	M. ☉ à Ap.	M. ☉ à ☊
	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″
100	10 7 4 53	11 29 3 2	8 11 34 17	4 14 56 47
200	8 14 9 46	11 28 6 4	4 23 8 34	8 29 53 34
300	6 21 14 39	11 27 9 6	1 4 42 51	1 14 50 21
400	4 28 19 32	11 26 12 8	9 16 17 8	5 29 47 8
500	3 5 24 25	11 25 15 10	5 27 51 25	10 14 43 55
600	1 12 29 18	11 24 18 12	2 9 25 42	2 29 40 42
700	11 19 34 11	11 23 21 14	10 20 59 59	7 14 37 29
800	9 26 39 4	11 22 24 16	7 2 34 16	11 29 34 16
900	8 3 43 57	11 21 27 18	3 14 8 33	4 14 31 3
1000	6 10 43 50	11 20 30 20	11 25 42 50	8 29 27 50
1100	4 17 53 43	11 19 33 22	8 7 17 7	1 14 24 37
1200	2 24 58 36	11 18 36 24	4 18 51 24	5 29 21 24

Julian Cent.	Mot. ☽ à ☉	M. ☉ An.	M. ☉ à ☽ Ap.	M. ☉ à ☊
	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″
1300	1 2 3 29	11 17 39 26	1 0 25 41	10 14 18 11
1400	11 9 8 22	11 16 42 28	9 11 59 58	2 29 14 58
1500	9 16 13 15	11 15 45 30	5 23 34 15	7 14 11 45
1600	7 23 18 8	11 14 48 32	2 5 8 32	11 29 8 32
1700	6 0 23 1	11 13 51 34	10 16 42 49	4 14 5 19
1800	4 7 27 54	11 12 54 36	6 28 17 6	8 29 2 6
1900	2 14 32 47	11 11 57 38	3 9 51 23	10 13 58 53
2000	0 21 37 40	11 11 0 40	11 21 25 40	5 28 5 40
2100	10 28 42 33	11 10 3 42	8 2 59 57	1 13 52 27
2200	9 5 47 26	11 9 6 44	4 14 24 14	2 28 49 14
2300	2 12 52 19	11 8 9 46	0 26 8 31	7 13 46 1
2400	5 19 57 12	11 7 12 48	9 7 42 48	11 28 42 48

Mean MOTION of the MOON from the SUN, &c. for MONTHS.

Ds.	Mths.	Mot. ☽ à Sun				Mot. ☉ Ano.				M. ☉ à ☽ Ap.				M. Sun à ☊			
		s	°	′	″	s	°	′	″	s	°	′	″	s	°	′	″
	Jan. 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	*Feb.* 0	0	17	54	48	1	0	33	13	0	27	6	5	1	2	11	48
59	*Mar.* 0	11	29	15	15	1	28	9	1	1	22	34	48	2	2	16	39
90	*April* 0	0	17	10	3	2	28	42	15	2	18	40	54	3	3	28	27
120	*May* 0	0	22	53	23	3	28	16	20	3	14	54	32	4	4	37	57
151	*June* 0	1	10	48	10	4	28	49	33	4	12	0	36	5	6	49	44
181	*July* 0	1	16	31	31	5	28	23	38	5	8	14	14	6	7	59	14
212	*Aug.* 0	2	4	26	19	6	28	56	50	6	5	20	19	7	10	11	1
243	*Sept.* 0	2	22	21	7	7	29	30	3	7	2	26	24	8	12	22	47
273	*Oct.* 0	2	28	4	27	8	29	4	8	7	28	40	2	9	13	32	18
304	*Nov.* 0	3	15	59	15	9	29	37	22	8	25	46	7	10	15	44	6
334	*Dec.* 0	3	21	42	36	10	29	11	26	9	21	59	45	11	16	53	35

Mean MOTION of the MOON from the SUN, &c. for DAYS

Days.	Mot. ☽ à Sun				M. Sun's An.				M. ☉ à ☽ Ap.				Mo. Sun à ☊			
	s	°	′	″	s	°	′	″	s	°	′	″	s	°	′	″
1	0	12	11	27	0	0	59	8	0	0	52	27	0	1	2	19
2	0	24	23	53	0	1	58	17	0	1	44	55	0	2	4	38
3	1	6	34	20	0	2	57	25	0	2	37	22	0	3	6	57
4	1	18	45	47	0	3	56	32	0	3	29	49	0	4	9	16
5	2	0	57	13	0	4	55	41	0	4	22	16	0	5	11	35
6	2	13	8	40	0	5	54	49	0	5	14	44	0	6	13	54
7	2	25	20	7	0	6	53	57	0	6	7	11	0	7	16	13
8	3	7	31	34	0	7	53	6	0	6	59	38	0	8	18	32
9	3	19	43	0	0	8	52	14	0	7	52	5	0	9	20	51
10	4	1	54	27	0	9	51	21	0	8	44	33	0	10	23	10
11	4	14	5	54	0	10	50	30	0	9	37	0	0	11	25	29
12	4	26	17	20	0	11	49	38	0	10	29	27	0	12	27	48
13	5	8	28	47	0	12	48	46	0	11	21	54	0	13	30	7
14	5	20	40	14	0	13	47	55	0	12	14	22	0	14	32	26
15	6	2	51	40	0	14	47	3	0	13	6	49	0	15	34	44
16	6	15	3	7	0	15	46	11	0	13	59	16	0	16	37	3
17	6	27	14	34	0	16	45	19	0	14	51	44	0	17	39	22
18	7	9	26	0	0	17	44	27	0	15	44	11	0	18	41	41
19	7	21	37	27	0	18	43	35	0	16	36	38	0	19	44	0
20	8	3	48	54	0	19	42	44	0	17	29	5	0	20	46	19
21	8	16	0	21	0	20	41	52	0	18	21	33	0	21	48	38
22	8	28	11	47	0	21	40	50	0	19	14	0	0	23	50	57
23	9	10	23	14	0	22	40	8	0	20	6	27	0	24	52	16
24	9	22	34	41	0	23	39	16	0	20	58	54	0	25	55	35
25	10	4	46	7	0	24	38	24	0	21	51	22	0	26	57	54
26	10	16	57	34	0	25	37	33	0	22	43	49	0	27	0	13
27	10	29	9	1	0	26	36	41	0	23	36	16	0	28	2	32
28	11	11	20	27	0	27	35	48	0	24	28	43	0	29	4	51
29	11	23	31	54	0	28	34	57	0	25	21	11	1	0	7	10
30	0	5	43	21	0	29	34	5	0	26	13	38	1	1	9	29
31	0	17	54	48	1	0	33	13	0	27	6	5	1	2	11	48

In *Jan.* and *Feb. Leap-Year,* take out for a Day sooner.

Mean MOTION of ☽ from ☉, &c. for *Hours, Minutes,* and *Seconds.*

H M S	Mot. ☽ à Sun			M. Sun's An.			M. ☉ à ☽ Ap.			M. Sun à ☊		
H	°	′	″	°	′	″	°	′	″	°	′	″
M	′	″	‴	′	″	‴	′	″	‴	′	″	‴
S	″	‴	iv	″	‴	iv	″	‴	iv	″	‴	iv
1	0	30	29	0	2	28	0	2	11	0	2	36
2	1	0	57	0	4	56	0	4	22	0	5	12
3	1	31	26	0	7	24	0	6	33	0	7	47
4	2	1	54	0	9	51	0	8	44	0	10	23
5	2	32	23	0	12	19	0	10	56	0	12	59
6	3	2	52	0	14	47	0	13	7	0	15	35
7	3	33	20	0	17	15	0	15	18	0	18	10
8	4	3	49	0	19	43	0	17	20	0	20	46
9	4	34	17	0	22	11	0	19	40	0	23	22
10	5	4	46	0	24	38	0	21	51	0	25	58
11	5	35	15	0	27	6	0	24	2	0	28	33
12	6	5	43	0	29	34	0	26	13	0	31	9
13	6	36	12	0	32	2	0	28	25	0	33	45
14	7	6	41	0	34	30	0	30	36	0	36	21
15	7	39	9	0	36	58	0	32	47	0	38	56
16	8	7	38	0	39	26	0	34	58	0	41	32
17	8	38	6	0	41	53	0	37	9	0	44	8
18	9	8	35	0	44	21	0	39	20	0	46	44
19	9	39	4	0	46	49	0	41	31	0	49	20
20	10	9	32	0	49	17	0	43	42	0	51	55
21	10	40	1	0	51	45	0	45	53	0	54	31
22	11	10	29	0	54	13	0	48	5	0	57	7
23	11	40	58	0	56	40	0	50	16	0	59	43
24	12	11	27	0	59	8	0	52	27	1	2	18
25	12	41	55	1	1	36	0	54	38	1	4	54
26	13	12	24	1	4	4	0	56	49	1	7	30
27	13	42	53	1	6	32	0	59	0	1	10	6
28	14	13	21	1	9	0	1	1	11	1	12	41
29	14	43	50	1	11	28	1	3	22	1	15	17
30	15	14	18	1	13	55	1	5	33	1	17	53
31	15	44	47	1	16	23	1	7	45	1	20	29
32	16	15	16	1	18	51	1	9	56	1	23	5
33	16	45	44	1	21	19	1	12	7	1	25	40
34	17	16	13	1	23	47	1	14	18	1	28	16
35	17	46	41	1	26	15	1	16	29	1	30	52
36	18	17	10	1	28	42	1	18	40	1	33	28
37	18	49	39	1	31	10	1	20	51	1	36	3
38	19	18	7	1	33	38	1	23	2	1	38	39
39	19	48	36	1	36	6	1	25	14	1	41	15
40	20	19	4	1	38	34	1	7	25	1	43	51
41	20	49	33	1	41	2	1	29	36	1	46	26
42	21	20	2	1	43	30	1	31	47	1	49	2
43	21	50	30	1	45	57	1	33	58	1	51	38
44	22	20	59	1	48	25	1	36	9	1	54	14
45	22	51	28	1	50	53	1	38	20	1	56	49
46	23	21	56	1	53	21	1	40	31	1	59	25
47	23	52	25	1	55	49	1	42	42	2	2	1
48	24	22	53	1	58	17	1	44	54	2	4	37
49	24	53	22	2	0	44	1	47	5	2	7	13
50	25	23	51	2	3	12	1	49	16	2	9	48
51	25	54	19	2	5	40	1	51	27	2	12	24
52	26	24	48	2	8	8	1	53	38	2	15	0
53	26	55	16	2	10	36	1	55	49	2	17	36
54	27	25	45	2	13	4	1	58	0	2	20	11
55	27	56	14	2	15	32	2	0	11	2	22	47
56	28	26	42	2	17	59	2	2	23	2	25	23
57	28	57	11	2	20	27	2	4	34	2	27	59
58	29	27	40	2	22	55	2	6	45	2	30	34
59	29	58	8	2	25	23	2	8	56	2	33	10
60	30	28	37	2	27	51	2	11	7	2	35	46

USE *of the* FOREGOING TABLES *of* MOON *from the Sun.*

COLLECT the Mean Places (from the Radical Places and Mean Motions connected) for the Beginning of that Month, in which the Mean Time of the Mean or true New or Full Moon is required. — Then connect therewith the *total Quantity* of Correction of M. Motion and Acceleration of the Moon, (*from Tab. p.* 374 foregoing) and the *Result* will give the corrected or true Mean Place of ☽ à ☉, at the Beginning of the said Month; connecting also the Variation of the ☽'s Ap. and ☊, corresponding to the said *total Correction,* (of contrary Signs) with the Places of ☉ à ☽'s Ap. and ☉ à ☊ (*according to p.* 374) the Place of the Sun's M. An. being *permanent,* as its Motion is esteem'd to be invariable. — Now deduct the final Place of ☽ à Sun from 12ˢ (if *New Moon is sought*) or from 6ˢ or 18ˢ, (if *Full Moon is sought*) and then take from the *Remainder,* in Mot. ☽ à Sun, for as many *Days, Hours, Minutes* and *Seconds* as can be deducted: For which *Days, Hours,* &c. you must add the correspondent Motions to the Sun's An. Sun à ☽ Ap. and Moon à Sun. By which *final* Places, you must obtain and subjoin to the Time of Mean *Syzygy,* the *Time,* with its proper Sign, answering, in Mot. ☽ à Sun, to the Sum of the Sun's *Equation,* and of the Sum of the Moon's annual, 6th, and *Elliptic Equation,* in Syzygies (taken out by the proper Arguments, and changing the Sign of the Sum of ☽'s Equations) for the true Time of the *New* or *Full* Moon required. See *Examples farther on.*

EQUATION of the MOON's CENTER (and II. Equation, Supplemental, compounded) at New and Full MOON. To be used with the 1st and 6th Supplemental Equations of the MOON, (the 6th to be doubled) p. 61, 62 and 74, and Sun's Equation, p. 12.

Argument. SUN from the *Moon's* Apogee I equated, at *New*; and + Six Signs at *Full* MOON.

Sun à ☽ Ap.	Sig. 0 —	Diff.	Sig. 1. —	Diff.	Sig. 2. —	Diff.	Sig. 3. —	Diff.	Sig. 4. —	Diff.	Sig. 5. —	Diff.	Sun à ☽ Ap.
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0		2 38 53		4 27 45		4 57 46		4 8 20		2 19 27		30
1	0 5 36	5 36	2 43 33	4 40	4 30 6	2 21	4 57 20	0 26	4 5 31	2 49	2 15 7	4 27	29
2	0 11 12	5 36	2 48 9	4 36	4 32 21	2 15	4 56 49	0 31	4 2 38	2 53	2 10 45	4 22	28
3	0 16 47	5 35	2 52 42	4 33	4 34 31	2 10	4 56 12	0 37	3 59 41	2 57	2 6 22	4 23	27
4	0 22 23	5 36	2 57 11	4 29	4 36 35	2 4	4 55 29	0 43	3 56 39	3 2	2 1 57	4 25	26
5	0 27 58	5 35	3 1 37	4 26	4 38 34	1 59	4 54 42	0 47	3 53 35	3 4	1 57 31	4 26	25
6	0 33 33	5 35	3 5 59	4 22	4 40 27	1 53	4 53 50	0 52	3 50 28	3 7	1 53 2	4 29	24
7	0 39 6	5 33	3 10 16	4 17	4 42 15	1 48	4 52 52	0 58	3 47 16	3 12	1 48 31	4 31	23
8	0 44 38	5 32	3 14 30	4 14	4 43 58	1 43	4 51 48	1 4	3 44 1	3 15	1 43 59	4 32	22
9	0 50 9	5 31	3 18 40	4 10	4 45 35	1 37	4 50 40	1 8	3 40 42	3 19	1 39 26	4 33	21
10	0 55 40	5 31	3 22 45	4 5	4 47 5	1 30	4 49 26	1 14	3 37 18	3 24	1 34 52	4 34	20
11	1 1 9	5 29	3 26 45	4 0	4 48 30	1 25	4 48 7	1 19	3 33 52	3 26	1 30 16	4 36	19
12	1 6 37	5 28	3 30 41	3 56	4 49 50	1 20	4 46 44	1 23	3 30 22	3 30	1 25 38	4 38	18
13	1 12 4	5 27	3 34 33	3 52	4 51 5	1 15	4 45 16	1 28	3 26 49	3 33	1 20 58	4 40	17
14	1 17 30	5 26	3 38 20	3 47	4 52 13	1 8	4 43 42	1 34	3 23 14	3 35	1 16 18	4 40	16
15	1 22 53	5 23	3 42 2	3 42	4 53 15	1 2	4 42 4	1 38	3 19 36	3 38	1 11 37	4 41	15
16	1 28 13	5 20	3 45 40	3 38	4 54 13	0 58	4 40 21	1 43	3 15 54	3 42	1 6 55	4 42	14
17	1 33 31	5 18	3 49 14	3 34	4 55 5	0 52	4 38 33	1 48	3 12 10	3 44	1 2 13	4 42	13
18	1 38 48	5 17	3 52 43	3 29	4 55 51	0 46	4 36 41	1 52	3 8 22	3 48	0 57 30	4 43	12
19	1 44 3	5 15	3 56 6	3 23	4 56 32	0 41	4 34 44	1 57	3 4 31	3 51	0 52 45	4 45	11
20	1 49 16	5 13	3 59 24	3 18	4 57 7	0 35	4 32 42	2 2	3 0 38	3 53	0 48 0	4 45	10
21	1 54 27	5 11	4 2 37	3 13	4 57 30	0 29	4 30 35	2 7	2 56 42	3 56	0 43 14	4 46	9
22	1 59 36	5 9	4 5 46	3 9	4 57 59	0 23	4 28 24	2 11	2 52 44	3 58	0 38 28	4 46	8
23	2 4 41	5 5	4 8 49	3 3	4 58 16	0 17	4 26 9	2 15	2 48 43	4 1	0 33 41	4 47	7
24	2 9 43	5 2	4 11 47	2 58	4 58 29	0 13	4 23 50	2 19	2 44 39	4 4	0 28 52	4 49	6
25	2 14 43	5 0	4 14 40	2 53	4 58 35	0 6	4 21 25	2 25	2 40 32	4 7	0 24 4	4 48	5
26	2 19 41	4 58	4 17 27	2 47	4 58 36	0 1	4 18 56	2 29	2 36 24	4 8	0 19 16	4 48	4
27	2 24 35	4 54	4 20 8	2 41	4 58 31	0 5	4 16 23	2 33	2 32 14	4 10	0 14 27	4 49	3
28	2 29 24	4 49	4 42 46	2 38	4 58 22	0 9	4 13 46	2 37	2 28 1	4 13	0 9 38	4 49	2
29	2 34 10	4 46	4 25 19	2 33	4 58 7	0 15	4 11 5	2 41	2 23 45	4 16	0 4 49	4 49	1
30	2 38 53	4 43	4 27 45	2 26	4 57 46	0 21	4 8 20	2 45	2 19 27	4 18	0 0 0	4 49	0
Sun à ☽ Ap.	+ Sig. 11	Diff.	+ Sig. 10	Diff.	+ Sig. 9.	Diff.	+ Sig. 8.	Diff.	+ Sig. 7	Diff.	+ Sig. 6.	Diff.	Sun à ☽ Ap.

The MOON's LATITUDE, INCLINATION and REDUCTION to the ECLIPTIC, at New and Full MOON.

Argument. Sun's *Distance* from the MOON's mean NODE, or Argument of Latitude.

Sun from Node.	Sig. 0 N. Sig. 6 S. Latitude.	Diff.	Reduction. —	Diff.	Inclinat. ☽'s Way to Ecliptic.	Diff.	Sig. 1 N. Sig. 7 S. Latitude	Diff.	Reduction. —	Diff.	Sig. 2 N. Sig. 8 S. Latitude	Diff.	Reduction. —	Diff.	Sun from Node
°	° ′ ″	′ ″	′ ″	″	° ′ ″	′ ″	° ′ ″	′ ″	′ ″	″	° ′ ″	′ ″	′ ″	″	°
0	0 0 0		0 0		5 17 20		2 30 12		6 1		4 19 39		5 59		30
1	0 5 15	5 15	0 14	14	5 17 17	0 3	2 34 42	4 36	6 8	7	4 22 13	2 34	5 51	8	29
2	0 10 30	5 15	0 29	15	5 17 8	0 9	2 39 9	4 27	6 14	6	4 24 42	2 29	5 43	8	28
3	0 15 44	5 14	0 43	14	5 16 54	0 14	2 43 34	4 25	6 20	6	4 27 6	2 24	5 35	8	27
4	0 20 59	5 15	0 58	15	5 16 33	0 21	2 47 56	4 22	6 26	6	4 29 25	2 19	5 26	9	26
5	0 26 13	5 14	1 12	14	5 16 6	0 27	2 52 15	4 19	6 31	5	4 31 40	2 15	5 17	8	25
6	0 31 26	5 13	1 26	14	5 15 33	0 33	2 56 30	4 15	6 36	5	4 33 4[illegible]	2 9	5 8	9	24
7	0 36 39	5 13	1 41	15	5 14 55	0 38	3 0 42	4 12	6 40	4	4 35 53	2 4	4 58	10	23
8	0 41 51	5 12	1 55	14	5 14 11	0 44	3 4 51	4 9	6 43	3	4 37 52	1 59	4 48	10	22
9	0 47 2	5 11	2 9	14	5 13 22	0 49	3 8 56	4 5	6 46	3	4 39 47	1 55	4 37	11	21
10	0 52 13	5 11	2 22	13	5 12 27	0 55	3 12 58	4 2	6 49	3	4 41 37	1 50	4 26	11	20
11	0 57 23	5 10	2 36	14	5 11 26	1 1	3 16 56	3 58	6 52	3	4 43 21	1 44	4 15	11	19
12	1 2 31	5 8	2 49	13	5 10 19	1 7	3 20 51	3 55	6 54	2	4 45 0	1 39	4 3	12	18
13	1 7 38	5 7	3 3	14	5 9 6	1 3	3 24 42	3 51	6 55	1	4 46 34	1 34	3 51	12	17
14	1 12 44	5 6	3 16	13	5 7 47	1 19	3 28 29	3 47	6 56	1	4 48 3	1 29	3 39	12	16
15	1 17 49	5 5	3 29	13	5 6 22	1 25	3 32 12	3 43	6 56	0	4 49 26	1 23	3 27	12	15
16	1 22 52	5 3	3 41	12	5 4 52	1 30	3 35 51	3 39	6 55	1	4 50 44	1 18	3 14	13	14
17	1 27 54	5 2	3 53	12	5 3 16	1 36	3 39 26	3 35	6 54	1	4 51 57	1 13	3 1	13	13
18	1 32 54	5 0	4 5	12	5 1 35	2 41	3 42 57	3 31	6 53	1	4 53 4	1 7	2 48	13	12
19	1 37 52	4 58	4 17	12	4 59 49	1 46	3 46 24	3 27	6 51	2	4 54 6	1 2	2 35	13	11
20	1 42 49	4 57	4 28	11	4 57 58	1 53	3 49 48	3 24	6 49	2	4 55 3	0 57	2 21	14	10
21	1 47 44	4 55	4 39	11	4 55 58	1 58	3 53 7	3 19	6 46	3	4 55 55	0 52	2 8	13	9
22	1 52 37	4 53	4 50	11	4 53 55	2 3	3 56 22	3 15	6 43	3	4 56 42	0 47	1 54	14	8
23	1 57 27	4 50	5 0	10	4 51 47	2 8	3 59 33	3 11	6 39	4	4 57 23	0 41	1 40	14	7
24	2 2 15	4 48	5 10	10	4 49 33	2 14	4 2 39	3 6	6 35	4	4 57 58	0 35	1 26	14	6
25	2 7 0	4 45	5 20	10	4 47 14	2 19	4 5 40	3 1	6 30	5	4 58 27	0 29	1 12	14	5
26	2 11 43	4 43	5 29	9	4 44 50	2 24	4 8 36	2 56	6 25	5	4 58 51	0 24	0 58	15	4
27	2 16 24	4 41	5 38	9	4 42 20	2 30	4 11 28	2 52	6 19	6	4 59 10	0 19	0 43	15	3
28	2 21 2	4 38	5 46	8	4 39 45	2 35	4 14 16	2 48	6 13	6	4 59 24	0 14	0 29	14	2
29	2 25 38	4 37	5 54	8	4 37 5	2 40	4 17 0	2 44	6 6	7	4 59 32	0 8	0 14	15	1
30	2 30 12	4 34	6 1	7	4 34 10	2 46	4 19 39	2 39	6 59	7	4 59 35	0 3	0 0	14	0
Sun from Node.	Latitude Sig. 11 S. Sig. 5 N.	Diff.	+ Reduction.	Diff.	Inclinat. ☽'s Way to Ecliptic.	Diff.	Latitude Sig. 10 S. Sig. 4 N.	Diff.	+ Reduction.	Diff.	Latitude Sig. 9 S. Sig. 3 N.	Diff.	+ Reduction.	Diff.	Sun from Node

THE true Hourly MOTIONS, DIAMETERS, and PARALLAXES of the SUN and MOON, in ECLIPSES.
N. B. In Eclipses of the Moon, add 6 Signs to the Arg. *Annuum*, or ☉ à ☽ Ap. 1 equated.

Sun's M. Anomaly	Sun's true Hourly Motion.	Sun's Diameter.	Sun's M. Anomaly	Sun from Moon's Apogee.	☽'s true Hourly Motion.	Moon's Horizont. Diameter.	Moon's Horizont. Parallax.	Sun from Moon's Apogee.	Sun & Moon's Altit.	Sun's Paral-lax.	Increase of Sun & ☽'s Diameter. Apog.	Perig.
s °	′ ″	′ ″	° s	s °	′ ″	′ ″	′ ″	° s	°	″	″	″
0 0	2 23	31 38	0 12	0 0	29 33	29 25	53 28	0 12	0	11	0	0
5	2 23	31 38	25	5	29 36	29 25	53 29	25	2	11	1	1
10	2 23	31 38	20	10	29 39	29 26	53 31	20	4	11	2	2
15	2 23	31 39	15	15	29 39	29 28	53 35	15	6	11	3	4
20	2 23	31 40	10	20	29 45	29 30	53 41	10	8	11	4	5
25	2 23	31 41	5	25	29 53	29 34	53 48	5	10	11	5	6
1 0	2 24	31 42	0 11	1 0	30 1	29 40	53 57	0 11	12	11	6	7
5	2 24	31 43	25	5	30 11	29 46	54 7	25	14	11	7	9
10	2 24	31 45	20	10	30 22	29 51	54 18	20	16	11	8	10
15	2 24	31 47	15	15	30 36	29 58	54 32	15	18	11	9	11
20	2 25	31 49	10	20	30 50	30 5	54 45	10	20	11	10	12
25	2 25	31 51	5	25	31 6	30 14	55 0	5	22	11	10	13
2 0	2 25	31 53	0 10	2 0	31 23	30 23	55 16	0 10	24	10	11	15
5	2 26	31 56	25	5	31 42	30 32	55 33	25	26	10	12	16
10	2 26	31 59	20	10	32 [illegible]	30 42	55 51	20	28	10	13	17
15	2 26	32 1	15	15	32 23	30 52	56 10	15	30	10	14	18
20	2 27	32 4	10	22	32 45	31 3	56 30	10	32	10	15	19
25	2 27	32 7	5	25	33 8	31 14	56 49	5	34	9	16	20
3 0	2 28	32 10	0 9	3 0	33 32	31 25	57 9	0 9	36	9	16	21
5	2 28	32 13	25	5	33 56	31 36	57 29	25	39	9	18	23
10	2 28	32 15	20	10	34 21	31 47	57 49	20	42	9	19	24
15	2 29	32 18	15	15	34 45	31 58	58 9	15	45	8	20	25
20	2 29	32 21	10	20	35 8	32 9	58 28	10	48	7	21	27
25	2 30	32 23	5	25	35 31	32 20	58 47	5	51	7	22	28
4 0	2 30	32 26	0 8	4 0	35 54	32 30	59 5	0 8	54	6	23	29
5	2 31	32 29	25	5	36 14	32 39	59 23	25	57	6	23	30
10	2 31	32 31	20	10	36 34	32 48	59 40	20	60	5	24	31
15	2 31	32 33	15	15	36 53	32 57	59 55	15	63	5	25	32
20	2 32	32 35	10	20	37 10	33 5	60 10	10	66	4	26	33
25	2 32	32 37	5	25	37 24	33 12	60 23	5	69	4	26	34
5 0	2 32	32 39	0 7	5 0	37 39	33 18	60 34	0 7	72	3	27	34
5	2 32	32 40	25	5	37 50	33 24	60 44	25	75	3	27	35
10	2 33	32 41	20	10	38 0	33 28	60 52	20	78	2	27	35
15	2 33	32 42	15	15	38 6	33 31	60 58	15	81	1	28	36
20	2 33	32 43	10	20	38 14	33 34	61 3	10	84	0	28	36
25	2 33	32 43	5	25	38 17	33 36	61 6	5	87	0	28	36
6 0	2 33	32 43	0 6	6 0	38 18	33 36	61 7	0 6	90	0	29	36

The TIMES between the true Ecliptic *Conjunction* or *Opposition* of the Sun and Moon, and the *Middle of Eclipse*, or greatest Obscuration, at the nearest Dist. of their Centers. Half of which Times, with the same Signs, will be nearly the Difference between the Orbit Syzygy and said Middle of the Eclipse.

☽ à ☊ Sig. 0.6.	True *Hourly* MOTION of the MOON from the SUN. 27′	28′	29′	30′	31′	32′	33′	34′	35′	36′	☽ à ☊ Sig. 5.11.
°	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	°
0	0m 0s	0m 0s	0m 0s	0m 0s	0m 0s	0m 0s	0m 0s	0m 0s	0m 0s	0m 0s	30
1	1 14	1 11	1 8	1 6	1 4	1 2	1 0	0 58	0 56	0 54	29
2	2 28	2 22	2 17	2 12	2 7	2 3	1 59	1 55	1 52	1 48	28
3	3 41	3 33	3 25	3 17	3 10	3 4	2 58	2 52	2 47	2 42	27
4	4 54	4 43	4 32	4 23	4 13	4 5	3 57	3 49	3 42	3 36	26
5	6 7	5 53	5 40	5 28	5 16	5 5	4 55	4 46	4 38	4 29	25
6	7 19	7 2	6 46	6 32	6 18	6 5	5 54	5 43	5 32	5 22	24
7	8 30	8 10	7 52	7 36	7 20	7 5	6 52	6 39	6 26	6 15	23
8	9 41	9 18	8 58	8 39	8 21	8 4	7 49	7 34	7 20	7 7	22
9	10 51	10 26	10 3	9 41	9 22	9 3	8 45	8 28	8 13	7 58	21
10	12 0	11 32	11 7	10 43	10 21	10 1	9 41	9 23	9 5	8 49	20
11	13 8	12 38	12 10	11 44	11 20	10 57	10 36	10 16	9 57	9 39	19
12	14 16	13 43	13 13	12 44	12 18	11 53	11 30	11 8	10 48	10 28	18
13	15 22	14 46	14 14	13 43	13 15	12 48	12 23	11 59	11 38	11 16	17
14	16 26	15 48	15 13	14 40	14 10	13 42	13 15	12 50	12 27	12 4	16
15	17 29	16 49	16 11	15 37	15 4	14 34	14 6	13 39	13 14	12 50	15
16	18 30	17 48	17 9	16 32	15 58	15 26	14 56	14 27	14 1	13 35	14
17	[illegible] 30	18 46	18 5	17 26	16 [illegible]	16 16	15 44	15 15	14 47	14 20	13
	+	+	+	+	+	+	+	+	+	+	

N. B. *As hourly Mot.* ☽ à ☉ : 60 *Min. of Time* :: *Reduction to Ecliptic in Min and Sec. of Deg.* : *Reduc. in Min. and Sec. of Time, from the Orbit to the Ecliptic Syzygy, and also to the Middle of the Eclipse. — Which being contrarily situated from the Orbit Syzygy, double the said Time will be nearly the Reduction from Ecliptic Conjunction or Opposition to Middle of Eclipse; having the same Signs with the Reduction Equation to the Middle of Eclipse from the Orbit Syzygy. And therefore the Reduction from Middle of the Eclipse to the Orbit Syzygy, or from the Orbit to the Ecliptic Syzygy, by Half the whole Equation, must be with a contrary Sign.*

The

The ANGLES which the Way of the MOON from the SUN makes with a Circle of LATITUDE: In ECLIPSES of those LUMINARIES.

☽ à ☊.	True *hourly* MOTION of the MOON from the SUN.										☽ à ☊.
Sig. 0.6.	27′	28′	29′	30′	31′	32′	33′	34′	35′	36′	Sig. 5. 11.
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	°
0	84 14	84 15	84 16	84 17	84 18	84 18	84 19	84 20	84 20	84 21	30
1	84 14	84 15	84 16	84 17	84 18	84 18	84 19	84 20	84 20	84 21	29
2	84 14	84 15	84 16	84 17	84 18	84 19	84 19	84 20	84 21	84 21	28
3	84 14	84 15	84 16	84 17	84 18	84 19	84 20	84 20	84 21	84 22	27
4	84 15	84 16	84 17	84 18	84 18	84 19	84 20	84 21	84 21	84 22	26
5	84 15	84 16	84 17	84 18	84 19	84 20	84 21	84 21	84 22	84 22	25
6	84 16	84 17	84 18	84 19	84 20	84 20	84 21	84 22	84 23	84 23	24
7	84 17	84 18	84 19	84 20	84 20	84 21	84 22	84 23	84 23	84 24	23
8	84 18	84 19	84 20	84 20	84 21	84 22	84 23	84 23	84 24	84 25	22
9	84 19	84 20	84 21	84 21	84 22	84 23	84 24	84 24	84 25	84 26	21
10	84 20	84 21	84 22	84 23	84 23	84 24	84 25	84 26	84 26	84 27	20
11	84 21	84 22	84 23	84 24	84 25	84 25	84 26	84 27	84 27	84 28	19
12	84 22	84 23	84 24	84 25	84 26	84 27	84 27	84 28	84 29	84 29	18
13	84 24	84 25	84 26	84 26	84 27	84 28	84 29	84 29	84 30	84 31	17
14	84 25	84 26	84 27	84 28	84 29	84 30	84 30	84 31	84 32	84 32	16
15	84 27	84 28	84 29	84 30	84 30	84 31	84 32	84 33	84 33	84 34	15
16	84 29	84 30	84 31	84 31	84 32	84 33	84 34	84 34	84 35	84 36	14
17	84 31	84 31	84 32	84 33	84 34	84 35	84 35	84 36	84 37	84 37	13

☞ The Complement of these Angles to 90° shews the *Angles* that the Way of the *Moon* from the Sun makes with the *Ecliptic*.

EXAMPLE. I. *To find the mean Time of the mean and true Orbit* NEW MOON *for the Month of* May, *in the 585th Year current before Christ?*

By the Nature of *Construction* of the *Tables*, 1 Year current before *Christ* is represented by 0, 101 before *Christ*, by 100, in the Tables, &c. each current Year before Christ by 1 *less* in the Tables, as we have noticed in our foregoing Improvements of Chronology; consequently the 585th Year current before Christ is represented by 584 in the *Tables*. And, since 584 before, + 1716 since Christ = 23 complete *Centuries*, or 2300 Years, by the Tables, from the Beginning of the 585th Year current before Christ, to the Beginning of the 1716th Year current since Christ. Therefore, by *Tab. P.* 385.

Dates, &c.	*1st m. n.* ☽ Jan. d h m s	*Sun's M. Anom.* s ° ′ ″	*Sun à* ☽*'s Ap.* s ° ′ ″	*Sun à* ☊. s ° ′ ″
1716 since Chr. O.S. Jan.	12 16 4 48	6 24 35 33	2 12 36 6	2 25 56 32
Sub. 2300 Yrs Mot. . —	11 5 57 54	11 19 15 5	1 5 58 33	7 25 26 59
Rem. 585 bef. Chr. *Jan.* .	1 10 6 54	7 5 20 28	1 6 37 33	7 0 29 33
May Biss. 1 Day less.	26 15 40 15	4 25 31 37	4 9 5 2	5 3 21 10
M. Time Mean new ☽, *May*	28 1 47 9	0 0 52 5	5 15 42 35	0 3 50 43
Eq. T. bet. M. and tr. ☽ .. +	. . 2 13 23	6 15 9 13	1 Eq. Ap. cont. + 17	1 Eq. ☊ cont. — 8
		Arg. 6. Equat.		
M. Time tr. new ☽ req. *May*	28 4 0 32	*Supplemental,*	5 15 42 52	0 3 50 35
in 585 Yr. curt. bef. Chr. O.S.		P. 74.	Eq. Sun — 1 43	Eq. Sun — 1 43
By Tab. P. 390, ☽ Lat. N.	. . . 20 0			
			5 15 41 9	0 3 48 52
			True Arg. of central Equation at *new Moon.*	True Sun à ☊, 1 eq. being much *less* than 18°, the Sun's eclipsed Limits, theref. the ☉ at this Time is greatly eclipsed.

Equations of the Moon with contrary Signs.

		° ′ ″
1 Equat. P. 61.	—	0 0 10
6 Equat. doubled, P. 74.	+	0 1 14
Equat. at *N.* and *F.* ☽. P. 390. . . .	+	1 8 24
Sum Equat. ☽ . .	+	1 9 28
Equat. Sun. P. 12. . .	—	1 43
Sum Eqs. = M. Dist. ☽ à ☉,	+	1 7 45
at true Conj. . . *Hours* 2 . .		1 0 57
		6 48
Minutes 13 . .		6 36
Seconds 23 . .		12

⁎ *At this Time a great Eclipse of the Sun happened, that put an End to the Battle then fighting between the* Medes *and* Lydians, *on which Peace ensued.* — This Eclipse happened above 2 Hours later at the Meridian where the Battle was fought, near the River *Halys*, the Boundary betwixt *Media* and *Lydia*, in *Asia Minor*, in the 4th Year of the 48th *Olympiad*, according to *Herodotus*, as predicted by *Thales*, of *Miletus*, or *Sardis*, in *Asia*. — But *Ferguson*'s *Astr. P.* 168, will have this Eclipse to be in 603 Year bef. Chr. *May* 18, 8h 30m Forenoon, (*London*-Meridian) 18 Yrs sooner. The Sun was then above 4 Degrees from the Moon's Node.

The Dominical Letters for this Year (Bissextile) being FE, *according to Table of Chronology*, P. 148, May 28, *in the 585th Year current, before Christ, the Day on which this Eclipse happened was on a* Wednesday. *In which Year the Cycle of the Sun was* 13, *Golden Number* 6, *and Roman Indiction* 4; *being in the 4129th Year of the* Julian *Period.* And 1716, since Christ, being in the 6429th Year of the *Julian Period*, the Difference = 2300 Years aforesaid.

☞ Mr. *C. Brent*, (in P. 341, *Compend. Astron.*) makes the 28th of *May*, on which this Eclipse happened, to be on a *Monday*, instead of on *Wednesday*, (observed also in *Ferguson's Astronomy*) which we should not have here noticed, had he not disputed (in *Lond. Mag. for April*, 1760) the Truth, by pretending "*It was* 585 *Years complete, before Christ*, (i. e. 586 current) *then not Leap-Year; when* G *was the Dominical* "*Letter.*" *That* "*Otherwise the Eclipse (according to* Newton's *Chronology) could not have been on* May 28." Whereas there was no Eclipse in the 586th Year current before Christ, on *May* 28, when the Dominical Letter was G and Cycle of Sun 12, (his Rule, P. 341, *Compend. Astr.* for finding the Sun's Cycle, not true) so it must be on the 28th of *May*, in the 585th Year current, before Christ, on a *Wednesday*, according to *Newton*'s Chronology) when this Eclipse happened; as the *Computation* proves above; and as his own Computation proves (*P.* 340. *Comp. Astr.*) of 2320 Years completed back from *May* 1, 1736, since Christ, to *May* 1, 585, before Christ; who has the same Mistake, P. 345, 346, *Compend. Astr.* making the 12th of *March*, in the 4th Year before Christ, on *Sunday*, the Dominical Letters BA (though not Leap-Year) for the 12th of *March*, in the 5th Year, *before Christ*.

☞ *For Years and Months, since Christ, you must add or subtract the Years and Months Motion forward or backward, to and from the* Years, Time *over and above, and* Places, *answering to* January *in the Eighteenth Century*, P. 385.

EXAMPLE

EXAMPLE II. To find the true Places of the *Sun* and *Moon* at the Time of the foregoing *Eclipse* of the *Sun*, according to the Moon's true Orbit-Conjunction?

RULE. *Compute the Sun's Apogee to the* Time *of the mean new Moon, and annex the other mean Places, foregoing, to that Time. Then add the Motion answerable to the* Equation of Time, *if that adds; or subtract, if that subtracts; for the mean Places, at the true Syzygy.* Then add the Sun's Apogee and Anomaly for the Sun's mean Place, from which taking the *Sun à ☽'s Ap. and Sun from Moon's Node, there will remain the Places of the Moon's Apogee and Node. And the Sun à Moon's Apogee added to Moon à Sun will give the Moon's Anomaly. The Sum of which and ☽'s Ap. = M. Pl. ☽; with which connect the proper Equations as below for the Moon's true Place. The Sun's true Place being had from the Sun's Equation connected with his mean Place, before found.*

The METHOD of COMPUTATION below is intirely NEW.

	Sun's Apog.	Sun's M. An.	Sun à ☽'s Ap.	Sun à ☊.	☽ à ☉.	
1716 since Ch. *May* 28	3s 8° 0′ 18″					
Sub. 2300 Years Motion —	1 9 17 30	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″	
585 bef. Ch. *May* 28d 1h 47m 9s	1 28 42 48	0 0 52 5	5 15 42 35	0 3 50 43	0 0 0 0	
Add for Equations. 12	. . . . . .	. . . 4 56	. . . 4 22	. . . 5 12	0 1 0 57	
M. 13 S. 23	. . . . . .	 33	 29	 35	6 48	
585, *May* 28d 4h 0m 32s	Sun's M. An.	0 0 57 34	5 15 47 26	0 3 56 30	0 1 7 45	
Past, — 1 21	Sun's Ap. +	1 28 42 48	1 29 40 22	1 29 40 22	5 15 47 26	+
28 3 59 11	Sun's M. Place	1 29 40 22	Ap. 8 13 52 56	☊ 1 25 43 52	5 16 55 11	☽ An.
Correct mean	Sun's Equation	— 1 54	— 1 28 42 48	☉ 1 29 39 9	8 13 52 56	☽ Ap.
Time of the *New*	Sun's true Pl.	1 29 38 28	6 15 10 8	0 3 55 17	2 0 48 7	☽
Moon, required, or	☽ tr. Orb Pl.	1 29 39 9	Arg. 6 Eqn. P. 74.	[Arg. ☽'s Lat.		
Orbit-Conjunction.			5 15 45 32	1 Eq. P. 61 . . +	0 0 11	
	Diff.	+ 41	Arg. cent. Eq. past	6 Eq. doubled, P. 74. —	0 1 15	
			Conjunction, = 1m	Eq. at New and Full —	1 7 54	
			21s to be deducted.			
				Moon's true Orb. Place	1 29 39 9	
				Moon's Latitude	20 34	N.

PROPOSITION.

The Sum of the Moon's Equations in Syzygies *connected by a contrary Sign with the Sun's Equation, and its proper Sign, will be the Distance of Time, nearly, in mean Motion, of the Moon from the Sun, on this Side, or beyond, a true* Conjunction *or* Opposition *of the Sun and Moon, from the Time of a mean* Syzygy.

DEMONSTRATION. Let ☽ and ☉ represent the Sun and Moon's mean Places, respectively, at the Time of a true Orbit-Conjunction or Opposition of the *Moon* and *Sun*. ☽ — ☉ will be the mean Distance of the Moon from the Sun at that Time. Let ± S denote the *Sun's Equation*, and ± M denote the *Sum* of the Moon's Equations, at the Time of a mean *Syzygy*. *Now* because there is but *small Difference* between the Equations for the Sun and Moon's mean Places, at the Time of a mean and true Syzygy (especially when the Interval is small.) Therefore, ☽ ± M min. ☉ ± S = 0, or 6 Signs, *nearly* at the true Syzygy. *Consequently*, Mean Distance = ☽ — ☉ = ± S ∓ M + 0 or 6 Signs, by *Transposition*. *That is*, the mean Distance of the Moon from the Sun, at the *true* Syzygy nearly = *Sum* of the Sun's Equation S, with its proper Sign, and the Moon's Equation M, with a *contrary* Sign, + 0, or 6 *Signs*, at mean Conjunction or Opposition, respectively. And therefore, that *Sum* reduced to *Time*, in mean Motion of the Moon from the Sun, reckoned from 0, or 6s ☽ from ☉ at the mean Syzygy, and that Interval of Time *added* or *deducted* to or from the Time* of mean *Syzygy*, according as the Moon's true Place is short of, or beyond, the Sun's true Place, or its Opposite, as the Sign of those Equations in one Sum directs, will give the *mean Time of the true Syzygy*, required, very *nearly*: And the *more* nearly the *less the Interval* happens to be; because then the Moon and Sun's Equations at mean and true Syzygy are the nearer alike. Q. E. D.

If greater *Accuracy* be required, the Equations of the *Sun* and *Moon* may be again found from the Arguments to the last near Time of the true *Syzygy*, and the *Difference* between the Sum of those, and the Sum of the former Equations taken, and reduced to Time, in Motion of the Moon from the Sun, and *added* to, or *subducted* from the last near Time, according as the Sign of the Difference of the Sum of the former, taken from the Sum of the latter of those Equations, directs, will give the *correcter* Time of the true *Syzygy*, and so on. Or the Sun and Moon's true Places may be found to the *nearly* true *Syzygy*, and the *Difference* of those Places, reduced to Time, in mean Motion ☽ fr. ☉, and added to, or subtracted from, the Time of the nearly true *Syzygy*, according as the Moon's true Place is *behind* or *before* the Sun's true Place, will give the *correcter* Time, required.

PRECEPTS for finding the TIMES and PLACES of ORBIT NEW and FULL MOONS.

TO *find the mean* TIME *of the nearly true* ORBIT CONJUNCTION *or* OPPOSITION *of the* SUN *and* MOON?

From *Table*, (P. 385) of the 1st mean *New Moon* in *January*, according to *Old Style*, collect the Days, and Parts of a Day, answering to the Year and Month (taking out a Day *less* in Leap-Year after *February*) and collect also the *Degrees* and *Parts* of a Degree of the Sun's mean Anomaly, mean Distance of the Sun from the Moon's *Apogee*, and *Node*; which are the same for Leap as for common Years. Or, if the Time of the *next* following or foregoing *Full Moon*, in any Month, is required, you must *add* or *subtract*, to or from the Time, and Places, of the mean *New Moon*, respectively, the Time and Motion for Half a *synodical* Month, to be found at the Bottom of the Months.

From *Table*, I. Equation ☽, (P. 61 and 62) take out the Equations of the *Moon*, *Apogee*, and *Node*, answering to the *Sun's mean Anomaly*, which apply to the former Places, with a *contrary* Sign to that directed in the *Tables*, and you will have the Sun's Distance from the *Apogee* and *Node*, once equated. Add to these, or subtract therefrom, (according to its Title) the *Sun's Equation*, and you will have the true Dist. ☉ from ☽'s Apogee, and true Dist. ☉ from ☊ 1. equated.

The mean Distance of the Sun from the Moon's Apogee 1 equated, being subtracted from the Sun's mean Anomaly, the *Remainder* will be the Argument of the VI. Equation *supplemental*, P. 74, at *New Moon*; but at *Full Moon*, this Argument, and also that of the Sun from the Moon's Apogee, for the central Equation in *Syzygies*, must be increased by 6 *Signs added to each*; because the Arg. 6 Equat. at Opposition, = ☽ à ☉ + ☽ Ap. — ☉ Ap. = 6s + ☽ Ap. — ☉ Ap. And Arg. *central* Equation, at Opposition, = ☽ Anom. + 6 Signs = ☉ from ☽'s Ap. + 6 Signs.

In P. 61 and 62, find *1st*, or annual Equation of the Moon, with a *contrary* Sign, according to the Sun's mean Anomaly. In P. 74, find 6. *Equation supplemental*, answering to the proper Argument; which Equation you must *double*, and connect its *contrary* Sign. In P. 300, find the central Equation, at *New* or *Full*, from its proper Argument, with a *contrary* Sign, the Sum of these 3 Equations with their contrary Signs, (or, which amounts to the same Thing, the Sum of these 3 proper *lunar* Equations with a *contrary* Sign) connected with the *Equation of the Sun's Center* (which you must also find) with its *proper* Sign, will give the mean Distance of the Moon from the Sun, very nearly, at a true Conjunction or Opposition; which, reduced to Time, (by *Tab.* P. 389, of M. Mot. ☽ fr. ☉) will be nearly the *true Equation of mean Time, with its proper Sign*, for the *Interval* of Time, to be added to, or subtracted from, the Time of the mean *New* or *Full* Moon, at 0 or 6 Signs mean Dist. ☽ à ☉, for the mean Time of the nearly true Orbit Conjunction or Opposition, *required*.

* *In P. A 8 Halley's Astron. Tables, his Precept-Writer applies the* Excess *of the* Sun's Equation, *and Sum of the* Moon's Equations, *(reduced to Time, in mean Mot. ☽ à ☉) to the Time of the mean for that of the true* Syzygy, *without considering the Sign of the* greater, *and therefore errs in his Account of the true* Syzygy *preceding the mean, and in the mean preceding the true.*

PRECEPTS for finding the TIMES and PLACES of ORBIT NEW and FULL MOONS.

The Place of the ☊ subtracted from the Sun's true Place, in Conjunction, but from its opposite Place in Opposition, will give the *Argument* of the Moon's Latitude, in *Syzygies*; by which, and *Tab.* P. 390, the *Moon's Latitude* is found, and her Place in the Ecliptic, by *Reduction* from her Orbit-Place; both which Orbit and Ecliptic Places in the *Syzygies* are nearly the same.

But the Time between Ecliptic Conjunction or Opposition, and the Middle of Eclipses, is found by *Tab.* P. 391, Half of which Time is the Difference between an Orbit Syzygy and Middle of an Eclipse.

To determine the Sun and Moon's true PLACES, *correspondent to the mean Time of the near or true Orbit* CONJUNCTION *and* OPPOSITION?

Compute the Sun's Apogee (from *Tables* at the Beginning of this *Work*) to the Time of the mean *New* or *Full* Moon, and annex the other mean Places already found to that Time; with all which Places (of Sun's M. Anom. Sun from Moon's Ap. and ☊, and Moon from Sun, 0s or 6s) connect their respective Motions for the *Equation of Time*, or Interval, between the mean and nearly true Orbit *Syzygy*, according to the *proper* Sign. Then *add* the Sun's Apogee and mean Anom. ☽, for the Sun's mean Place, from which taking the Sun from the Moon's Apogee, and also Sun from Moon's ☊, there will remain the mean Places of the Moon's Apogee and Node. And the Sun from the Moon's Apogee, added to ☽ from ☉, will give the *Moon's mean Anomaly*. The Sum of which Moon's Anomaly, and Moon's Apogee *(before found)* will give the mean Place of the Moon in her *Orbit*, with which if you now connect her *proper* Equations 1, 6, and the central in *Syzygies*, taken out from the true or equated Arguments, *(in P. 61, 74, and 390) you will have the Moon's nearly true Place in her Orbit.*

The Sun's *true Place* being here also had from the Equation of his Center, the Distance of the Moon's from the Sun's true Place, *i. e.* the Remainder after the Sun is taken from the Moon's Place (being a *small Arc)* turned into Time (by *Tab. mean Mot.* ☽ à ☉) and *added* to or *subtracted* from the former Time of the Orbit *Syzygy*, according as the Moon's true Place is, by the Length of that Arc, *behind* or *before* the Sun's Place, will give the *correcter Time* of the Orbit *Syzygy*, required.

N. B. *In Orbit Opposition, or Full Moon, you must add 6 Signs to the Sun from the Moon's Apogee, for the Argument of the Moon's central Equation at that Time; and also 6 Signs must be added for the Argument of the 6. Equation, in Opposition.*

REMARK. In Dr. *Halley's Anomalystic Tables*, for computing the *Moon's Place*, at her *Orbit*-Conjunction or Opposition, (than which our common Tables are not less expeditious) the *1st* or *annual Equation* of the Moon, Apogee, and ☊, being connected or compounded with the Moon's mean Motion, Apogee, and ☊, answering to the Sun's *mean Anomaly*.

And in Imitation of Dr. *Halley*, we have also as usefully compounded the 1st *semiannual Equation* of the Moon, with the Moon's *central* Equation in *Syzygies*; having both the same *Arg. annuum*. (See P. 390) Which *central* Equation is computed by finding the mean from the true Anomaly of the Moon, and taking their Difference.

EXAMPLE III. *To find the mean Time of the mean and nearly true New Moon, or Orbit-Conjunction, in the Month of* April 1764, *since Christ* New Style?

☞ 11 Days must either be added to the Day of *Old Style*, in January, for the Day of *New Style*, correspondent, among the *Radixes*; or else a Month must be so taken, that when 11 Days are added to its Days corresponding, the Sum may come out in *April*, or the Month wherein the New or Full Moon is *required*, the *nearest* possible to the *first* Day of that Month.

	1st m. n. ☽ Jan.	*Sun's M. Anom.*	*Sun à Moon's Ap.*	*Sun à* ☊.	*Equations of the Moon with contrary Signs.*
Dates, &c.	d h m s	s ° ′ ″	s ° ′ ″	s ° ′ ″	
By P. 385. 1764 fin. Ch. O.S.	21 20 10 59	7 3 10 34	9 17 46 25	10 4 14 29	1 Equat. ☽, P. 61. + 0° 11′ 48″
Biss. *Feb.* (adding 11 Ds) *Mar.*	10 1 28 6	1 28 12 39	1 21 38 1	2 1 20 28	6 Eq. *doubled*, P. 74. + 0 4 28
					Eq. at *N.* ☽, P. . — 1 44 2
Reduces to *Apr.* N. S.	0 21 39 5	9 1 23 13	11 9 24 26	0 5 34 57	
Equat. bet. M. and true ☽	+ 55 2	— 11 9 4 27	1 Eq. cont. — 19 59	1 Eq. cont. + 9 29	— 1 27 46
					Sun's Equat. P. 12. — 1 55 43
M. Time *Orbit* N. ☽, *April*,	0 22 34 7	9 22 18 46	11 9 4 27	0 5 44 26	Sum, mean Dist.
1764, N. S. *required.*	Midd. of ☉ Ecl.	Arg. 6. Equat.	☉ Eq. + 1 55 43	☉ Eq. + 1 55 43	☽ à ☉, in Syzygy. + 27 57
According to *Ferguson's Astr.*		*supplemental,*			*Minutes* 55 . . 27 56
P. 198.	0 22 15 0	P. 74. at New	11 11 0 10	0 7 40 9	
		Moon.	*True* Arg. central Eq.	*True* Sun à ☊, 1 eqd.	*Seconds* 2 . . 1
Diff. . .	— 19 7		at *New Moon.*	the Sun *eclipsed* considerably.	Equation or *Interval* of Time, [+.

EXAMPLE IV. *To find the* true *Orbit Places of the* Sun *and* Moon, *at the Time of the foregoing* Eclipse *of the Sun, according to the Moon's nearly true* Conjunction?

	Sun's *Apogee.*	Sun's M. Anom.	Sun à ☽'s Ap.	Sun à ☊.	☽ à ☉.	
	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″	
1764, *March* 31, N. S.	3 8 49 18	9 1 23 13	11 9 24 26	0 5 34 57	0 0 0 0	
21h 39m 5s	By Tab. P. 389	. . . . 2 16	. . . . . 2 0	. . . . 2 23	. . . . 27 57	
Add for Eq. M. 55 S. 2						
22 34 7	Sun's M. An.	9 1 25 29	11 9 26 26	0 5 37 20	0 0 27 57	
Short + 18	Sun's Ap. +	3 8 49 18	0 10 14 47	0 10 14 47	11 9 26 26	+
	Sun's M. Pl.	0 10 14 47	Ap. 1 0 48 21	☊ 0 4 37 27	11 9 54 23	☽'s M. Anom.
1764, *Apr.* 0d 22 34 25	Sun's Equat.	+ 1 55 42	— 3 8 49 18	☉ 0 12 10 29	1 0 48 21	☽'s M. Apog.
Nearer Time.						
	Sun's true Pl.	0 12 10 29	9 21 59 3	0 7 33 2	0 10 42 44	☽'s M. Pl.
	☽ true Orb. Pl.	0 12 10 20	1 Eq. Ap. + 19 59	[Arg. ☽'s Lat.		
				1 Eq. prop. P. 61.	— 11 48	
		Diff. — 9	9 22 19 2	6 Eq. *doubled*, P. 74.	— 4 28	
		= 18s short of	Arg. 6. Equat.	Cent. Eq. at N. ☽.	+ 1 43 52	
		Conjunction.	11 11 2 9			
			Arg. *central* Eq.	☽'s true Orb. Pl.	0 12 10 20	Reduc. — 1′ 48″.
				Moon's Lat.	. . . . . 39 31	N.

☞ *If you find the* Sun *and* Moon's *true Places to the Time of mean* Syzygy, *and reduce what the* Moon *is short of, or beyond, a Conjunction or Opposition into* Time, *in mean Mot.* ☽ à ☉, *then this Time being added to or subtracted from the Time of mean Syzygy, it will give you nearly the Time of true Syzygy, required.*

EXAMPLE

EXAMPLE V. *To find the mean Time of the mean and nearly true Opposition or* Full Moon, *in the Month of* April, 1764?

1764.	*1st m. n.* ☽ Apr. d h m s	*Sun's M. Anom.* s ° ′ ″	*Sun à Moon's Ap.* s ° ′ ″	*Sun à* ☊. s ° ′ ″
From above, *April*, N. S.	0 21 39 5	9 1 23 13	11 9 24 26	0 5 34 57
½ Rev. or synod. Month, +	14 18 22 2	0 14 33 10	0 12 54 30	0 15 20 7
Mean Opposition, *April*	15 16 1 7	9 15 56 23	11 22 18 56	0 20 55 4
Eq. bet. M. and true Oppn	+ 4 45 27	—11 21 59 50	1 Eq. cont. — 19 6	1 Eq. cont. + 9 5
M. Time true Opposition, *Apr.* 1764, N. S. required . .	15 20 46 34	9 23 56 33 + 6	11 21 59 50 ⊙ Eq. + 1 44 57	0 21 4 9 ⊙ Eq. + 1 44 57
According to *Ferguson's Astr.* P. 199.	15 20 56 0	3 23 56 33 Arg. 6. Equat. P. 74. at Full ☽.	11 23 44 47 + 6	0 22 49 6 True Sun à ☊. Sun being above 12° from the ☊, here happens no Eclipse of the ☽, as near the opposite ☊.
Error	+ 19 26		5 23 44 47 Arg. central Equat. at Full Moon.	

Equations of the Moon with contrary Signs.
1 Equat. ☽, P. 61 +0° 11′ 19″
6 Eq. doubd, P. 74. —0 2 24
CenEq. at *Full*, p. 390 +0 30 5
Sum, + 39 0
Sun's Equat. + 1 44 57
Sum, M. Dif. ☽ à ⊙, +2 23 57 [in Syzygy.
Hours 4 . . 2 1 54
22 3
Minutes 45 . . 21 50
Seconds 27 . . 13
Equat. or *Interval* of Time, +.

N. B. *You may take out the 1st, 6th, and* central *Equations of* ☽ *as they are, and then connect the* Sum *thereof, changing the Sign, with the Equation of the Sun's Center, for the mean Dist.* ☽ *à* ⊙, *to be turned into Time, and used as above, connected, in its proper Sign, with the Time of the mean* Syzygy.

EXAMPLE VI. *To find the true Places of the Sun and Moon, at the Time of the foregoing nearly true Orbit* Opposition *of the Sun and Moon?*

	Sun's Apogee. s ° ′ ″	Sun's M. Anom. s ° ′ ″	Sun à ☽'s Apogee. s ° ′ ″	Sun à ☊. s ° ′ ″	☽ à Sun. s ° ′ ″	
1764, *Apr.* 15, N. S. 16h 1m 7s	3 8 49 20	9 15 56 23	11 22 18 56	0 20 55 4	0 0 0 0	
Add Equat. { 4	. . . . . .	. . . . 9 51	8 44	10 23	0 2 1 54	
. . 45 27	By *Tab.* P. 389	. . . . 1 52	1 39	1 58	23 5	
20 46 34	Sun's M. An	9 16 8 6	11 22 29 19	0 21 7 25	0 2 24 59	
Short + 2 45	Sun's Apogee	3 8 49 20	0 24 57 26	0 24 57 26	11 22 29 19	+
1764, *Apr.* 15d 20 49 19	Sun's M. Pl.	0 24 57 26	Ap. 1 2 28 7	☊ 0 3 50 1	11 24 54 18	☽'s M. Anom.
Nearer Time.	Sun's Equat.	+ 1 50 36	1. Eq. + 19 6	⊙ 0 26 48 2	1 2 28 7	☽'s M. Ap.
	Sun's true Pl	0 26 48 2	1 2 47 13	6 22 58 1	0 27 22 25	☽'s M. Pl.
	☽ tr. Orb. Pl.	0 26 46 38	— 3 8 49 20	[Arg. Lat.		
		— 1 24	9 23 57 53	1 Equat. ☽ . . .	. . . —11 19	
		= 2m 45s short of Opposition.	+ 6	6 Eq. ☽ doubled	+ 4 24	
				Eq. Center at Full	—28 52	
			3 23 57 53 Arg. 6. Equat.	True Orb. Pl. ☽	0 26 46 38	Reduc. — 5′.
				Moon's Lat.	. . 1 57 17	S.
			11 24 0 49 + 6	Sun à ☽ Ap.		
			5 24 0 49 Arg. cent. Equat. at *Full* Moon.			

N. B. The *Arg.* 6. Equat. = { ☽'s Ap. 1. eqd. — ⊙'s Ap. at New; but + 6s at Full Moon.

Arg. *Central* Eq. = { Pl. Sun — ☽'s Apog. 1. equated, at *New*; but + 6s at *Full* Moon.

EXAMPLE VII. *To find the Mean of Time of the* Moon's *mean and nearly true Orbit Conjunction with the Sun,* (by Table, P. 388.) *for the Month of* May *in the 585th Year current before* Christ, *according to the Moon's* Acceleration, *in* Tab. P. 374?

See *Precept* in *Tab.* P. 389.	☽ à Sun.	Sun's M. Anom.	Sun à Moon's Ap.	Sun à ☊.
1716 since *Christ*, O. S.	7s 7° 44′ 3″	6s 13° 5′ 27″	2s 2° 23′ 58″	2s 13° 49′ 19″
2300 Years Motion —	7 12 52 19	11 8 9 46	0 26 8 31	7 13 46 1
585 bef. *Chr.* current	11 24 51 44	7 4 55 41	1 6 15 27	7 0 3 18
Accelerat. & Cor. M Mot. P. 374.	☽ + 42 10*	. . . . . .	☽ Ap. + 1 28 10*	☊ — 44 54*
Corrected . .	11 25 33 54	7 4 55 41	1 7 43 37	6 29 18 24
May . .	0 22 53 23	3 28 16 20	3 14 54 32	4 4 37 57
—	0 48 27 17	11 3 12 1	4 22 38 9	11 3 56 21
	12	0 27 36 47	0 24 29 35	0 26 5 53
Remains . .	11 11 32 43	0 0 48 48	5 17 7 44	0 3 2 14
Days 28 . .	11 11 20 27	5 17 8 0	1 Eq. Ap. con. + 16	1 Eq. ☊ con. — 7
	12 16	6 13 40 48	5 17 8 0	0 3 2 7
Hours 0, *Minutes* 24	. . . 12 11	Arg. 6. Eq. P. 74.	Sun's Eq. — 1 36	Sun's Eq. — 1 36
Seconds 10	 5		1 17 6 24	0 3 0 31
In 585, *May* 28d 0h 24m 10s	M. Time M. New Moon.		True Arg. cent. Eq. at *New* Moon.	True Sun from Node, 1 equated. Sun greatly eclipsed.
Eq. Time + 2 0 8	the *Interval* bet. M. and tr. N. ☽.			
In 585, *May* 28 2 24 18 bef. Chr.	M. Time true Orbit N. ☽, reqd.			
4 0 32	Computed in Ex. I. P. 392.			
Dif. 1 36 14	sooner in 2300 Years Julian.			

By this *Method** the *Acceleration* and *Correction* of M. Mo. ☽, Ap. and ☊, is *connected* for the Begin of any Year, sin. Chr.
Accel. Ap. and ☊ connected [with a *contrary* Sign.

The Mot. of Sun's M. An. Sun à ☽ Ap. and ☊ are *added* for *Ds. Hrs. Min. &c.* as below. *Days* 28, *Ho.* 0, *M.* 24, *S.* 10. Mean Places correspondent.
Equations of Moon below.
1 Eq. ☽ prop. P. 61. +0° 0′ 10″
6 Eq. ☽ doub. P. 74. —0 1 4
Cen. Eq. N. ☽ p. 390 —1 1 43
+ *cont.* . . Sum — 1 2 37
Sun's Equat. — 0 1 36
+ Sig. ☽ Eq. } changed, Sum } +1 1 1
Mean Dist. ☽ à Sun, in Syzygy.
Hours 2 . . 1 0 57
Min. 0, *Sec.* 8 4
Equat. or *Interval* of Time, +.

☞ *To which Time the Sun and Moon's true Places may be computed, as in Example* II. *Or you may first take the Reduc.* ☽ *to Ecliptic, by Tab. P.* 392. *doubling the* ′ *and* ″ *for Min. and Sec. Reduc. Time; with a contrary Sign.*

EXAMPLE VIII. *To find the mean Time of the mean and nearly true Orbit Opposition, or Full Moon, in* March 1764; *without Acceleration and Correction of mean Motion.* See *Tables*, P. 388 and 389.

	Moon á Sun.	Sun's M. Anom.	Sun á Moon's Ap.	Sun á Node.	
	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″	
1664 since *Chr.* O. S.	5 8 51 6	6 13 35 5	0 17 58 57	4 27 39 0	
+100 Years Mot. . .	10 7 4 53	11 29 3 2	8 11 34 17	4 14 56 47	
March	11 29 15 15	1 28 9 1	1 22 34 48	2 2 16 39	
1764 *March*	3 15 11 14	8 10 47 8	10 22 8 2	11 14 52 26	
	6	0 5 54 49	0 5 14 44	0 6 13 54	*Days* 6, Motion:
Moon fr. Mean Opposit.	2 14 48 46	0 7 24	0 6 33	0 7 47	*Hours* 3.
N. S. 17. O.S. *Days* 6	2 13 8 40	0 42	0 37	0 44	*Minutes* 17, *Seconds* 4.
	1 40 6	8 16 50 3	10 27 29 56	11 21 14 51	*Places* correspond. to ☽ á Sun = 6s.
Hours 3	1 31 26	10 27 10 23	1 Eq. con. — 19 33	1 Eq. con. + 9 17	*Equations of the Moon below.*
	8 40	9 19 39 40	10 27 10 23	11 21 24 8	1 Equat. ☽, P. 62. — 0° 11′ 33″
Minutes 17	. . . . 8 38	+6	Sun'sEq. +1 53 18	Sun'sEq. +1 53 18	6 Eq. doubled, P. 74. + 0 4 33
Seconds 4	 2	3 19 39 40	10 29 3 41	11 23 17 26	Cent. Eq. ☽ at Full — 2 23 29
		Arg. 6. Eq. P. 74.	+ 6	True Sun á Node.	+ *centr.* . . Sum — 2 30 29
			4 29 3 41	Where Moon 7° from opposite ☋. Therefore ☽ *eclipsed* being *less* than 12° á ☋.	Sun's Equation . . + 1 53 18
			Arg. Cent. Eq. at Full Moon.		+Sig. ☽ Eq. changed, *Sum* + 4 23 47

Mean Dist. Moon á Sun, in Syzygy.
Hours 8 . . 4 3 49
19 58
Minutes 39 . . 19 48
Seconds 20 . . . 10

d h m s
In 1764, *March* 17 3 17 4, M. Time M. Full Moon.
Equat. Time + 8 39 20 *Interval* bet. M. and tr. Opp.

In 1764, *March* 17 11 56 24 N. S. M. Time true Orbit [Opposition, required.

In *Ferguson*'s Astronomy, (and also in a *New Work* bearing his Name we have seen at the Observatory at *Greenwich*, in *Manuscript*, examining the Times of *antient Eclipses*, referred to Dr. *Bradley*'s Inspection and Approbation) we find a *similar* Method to that above, for determining the mean Time of the mean and true Orbit Conjunction and Opposition of the Sun and Moon. But this Author *(erroneously)* gives the Sum of the Moon's Equations with a *contrary* Sign, and of the Sun's Equation with its *proper* Sign, reduced to Time in mean Motion of the *Moon (as his three lunar Equation Tables and Sun's Equation Table, there reduced to Time, evince)* instead of reducing those Equations to Time *(as we have demonstrated they should be reduced)* in mean Motion of the *Moon from the Sun.* Who therefore is greatly wide of Truth in his computed Times of *Lunations* and *Eclipses*, as follows.

According to Ferguson's *Astronomy.*

	d	h	m		
1761 *May*	4	5	4	New Moon.	
	18	10	24	Full Moon.	☽ Eclipse.
1764 *March*	31	22	15	New Moon.	
April	1	10	16	☉ Eclipse.	
April	15	20	56	Full Moon.	
1801 *March*	13	9	13	Mean New.	
424 *March*	9	20	29	New Moon.	
721 *March*	8	7	36	Full Moon.	

According to De la Caille's *Astronomy.*

May	4d	5h	37m	0s	New Moon.
	18	10	23	0	Full Moon. ☽ Ecl.
March	31	22	29	51	New Moon.
April	1	10	43	0	☉ Eclipse.
April	15	22	38	0	Full Moon.

For the Meridian of *Greenwich.*

☞ *If Dr.* Bradley *has not detected the foregoing Mistake in Judgment, we here observe it, that Mr.* Ferguson's *Computations, printed, or in Manuscript, may receive a general Revise and Correction; or new Edition of the whole Work.*

*** Mr. *Ferguson* deducts a Day in his 3 and 4th *Examples* above; though he proposes to avoid that *Inconveniences*, by beginning his Computations at *March*, instead of *January*, where they will admit of it; which appear no Advantage to us; but rather the contrary. — He says, *P.* 201, of his Astronomy, "*Our Saviour was born in a Leap Year,*" though the 1st Year *current* of Christ (at the Beginning of which our Saviour was born) was the 1st Year after Leap-Year, or after the Leap Year which was the 1st current before Christ; or why is 1 Year directed to be deducted out of the Years before Christ (before a Division of the Remainder by 4) to shew the 1, 2, 3, or 0 Year since Leap-Year, or when it is Bissextile; according as 3, 2, 1, or 0, remains?

PRECEPTS for finding the TIMES and PLACES of Ecliptic NEW and FULL MOONS.

To find the mean TIME *of the true Ecliptic** CONJUNCTION *or* OPPOSITION *of the* SUN *and* MOON?

RULE. To the mean Time of a *mean*, or that of a nearly true *New* or *Full* Moon (found by the foregoing Rules) compute the Sun and Moon's true Places, in the Ecliptic. And if they are *exactly* the same, or opposite, *(which seldom happens)* the Time of the true *New* or *Full* Moon is discovered. If they differ, note that *Difference*, and compute, again, the Sun and Moon's Places in the Ecliptic, for an *Hour before or after the Time*, for which you have their Places already computed; whereby you will gain the true *hourly* Motion of the Moon from the Sun in the Ecliptic.

Now say, *As the hourly Motion of the Moon from the Sun : is to 1 Hour or* 60m *of Time :: so is the Distance of the Moon from the Sun, at mean or nearly true New or Full Moon (or Difference of their Places before noted) : to the* Interval *of Time between the mean, or near Ecliptic* New *or* Full *Moon.* Which Time being *added* to, or *subtracted* from, the Time of the mean, or nearly true Conjunction or Opposition, according as the Moon's computed Place is short of, or beyond the Sun's computed Place, or its Opposite, at that Time, and you will have the mean Time (nearly) of the *true* Ecliptic Conjunction or Opposition of the *Sun* and *Moon*, required. When greater *Exactness* is wanted, compute again the Sun and Moon's true Places to the last found Time of Conjunction and Opposition, and if they are precisely the same, or opposite, you have your Desire; if otherwise, proportion for the Difference, to get the exact Time of Ecliptic Conjunction or Opposition.

* *A true Ecliptic Conjunction of the Sun and Moon happens when the Sun's true Place is the* same *with the Moon's true Ecliptic Place. And a true Ecliptic Opposition happens when the Sun's true Place is directly* opposite *to the Moon's true Ecliptic Place.*

PRECEPTS for finding the TIMES and PLACES of Ecliptic NEW and FULL MOONS.

EXAMPLE ~~IX~~ 9. *To find the Sun and Moon's true Places, at their Ecliptic Opposition, in the Year* 1764, *March* 17ᵈ 11ʰ 53ᵐ *nearly*. See Example VIII. P. 396.

	s ° ′ ″
Sun's true Place at that Time by first *Tables* . .	11 27 53 58
Moon's true Place by 1, 8, 9, 10, and 11 Equat. C.	5 27 38 46
Moon á Sun at that Time	5 29 44 48
Moon short of *Opposition*, or 6 Signs	15 12
Sun's true Place for an Hour later	11 27 56 27
Moon's true Place for that Time	5 28 16 35
Moon á Sun at that Time	6 0 20 8
Moon past an Opposition or 6ˢ	20 8
Hourly Motion of the Sun	2 29
Hourly Motion of the Moon	37 49
Hourly Motion of the Moon á Sun	35 20

Say 35′ 20″ :: 60ᵐ :: 15′ 12″ : 25ᵐ 49ˢ

~~Opposi~~ *March* 17ᵈ 11ʰ 53 0 +

Hence, the tr. *Ecliptic* ~~*Conj*~~. will be 1764, *Mar.* 17ᵈ 12ʰ 18ᵐ 49ˢ nearly.

By M. *De la Caille*'s Ephem. 1764, *Mar.* 17ᵈ 12ʰ 2ᵐ 16ˢ

☞ *The Time of this* Ecliptic *Opposition may be more nearly computed by using all the* Equation Tables *of the Moon.* C.

EXAMPLE X. *To find the foregoing* Ecliptic Opposition *of the Sun and Moon, on* March 17, *by the* Supplemental Equation Tables ☽, *of Mr.* Mayer, P. 97, *&c.*

	s ° ′ ″
Sun's true Place, 1764, *Mar.* 17ᵈ 11ʰ 53ᵐ, as before,	11 27 53 58
☽ tr. Ecliptic Pl. by 1, 11, 12, 13, and 14 Eq. *Mayer*,	5 27 42 18
Moon á Sun at that Time	5 29 48 20
Short of Ecliptic Opposition or 6 Signs by	11 40
Sun's true Place for an Hour later as before . . .	11 27 56 27
Moon's true Place for that Time	5 28 19 49
Moon á Sun at that Time	6 0 23 22
Moon past Opposition or 6ˢ	23 22
Hourly Motion of the Sun	2 29
Hourly Motion of the Moon	37 31
Hourly Motion of the Moon á Sun	35 2

Say 35′ 2″ : 60ᵐ :: 11′ 40″ : 19ᵐ 59ˢ

~~Opposi~~ *March* 17ᵈ 11ʰ 53 0 +

Hence the Eclipt. ~~Conj~~. *March* 17ᵈ 12ʰ 12ᵐ 59ˢ in 1764.

By M. *De la Caille*'s Eph. *March* 17 12 2 16 *Greenwich.*

~~Eclipse~~ 10 43 Dif.

☞ *The Time of this* Ecliptic *Opposition of the Sun and Moon may be also more nearly computed by using all* M. Mayer's *Eq. Tables*, P. 97, *&c.*

TO *determine the* NUMBER *of* ECLIPSES *in any* YEAR, *and on what* DAYS *of the* MONTH *they happen?*

By *Table*, P. 385, take out the Place of the Sun from the Node for the Beginning and Month-day of any Year in the 18th *Century*, which you may reduce to the Beginning and Month-day of any other Year, in a *remote* Century, by *adding* or *deducting* the Days, and Motion of the Sun from Node for the Century, or Centuries distant, forward or back of the Radical Days and Place of the Sun from the Node. Then *add* the Motion of the Sun from the Node for Months forward in that Year to make the Sun from the Node, at *New* and *Full*, come within the *Limits* of a *solar* or *lunar* Eclipse, for as many Months as possible, (which is done by Inspection of Motion of Sun from Node) *viz.* within 18° Sun from Node, at *New*; and 12°, at *Full* Moon.

EXAMPLE XI. *To determine the Number of Eclipses for the Year* 1764, *and on what Days they happen in that Year?*

By *Tab.* P. 385.	d h m s	Sun á Node. s ° ′ ″	All the ECLIPSES that *can* happen, in 1764.
O. S. New ☽, 1764 *Jan.*	21 20 10 59	10 4 14 29	
N. S. . . . . *Add*	11		☞ *The same may, as readily, be performed for any other Year, forward or back of the present Year.*
January	29 12 44 3	1 0 40 14	
½ Revolution	14 18 22 2	0 15 20 7	
Full. March	17 3 17 14	11 20 14 50	Moon 10° *short* of South Node. *Eclipse* ☽. I.
½ Revolution +	14 18 22 2	0 15 20 7	
New. March	31 21 39 6	0 5 34 57	Sun 5° ½ *past* N. Node. *Eclipse* Sun. II.

	d h m s	s ° ′ ″	
Again, O. S. 1764, *January*	21 20 10 59	10 4 14 29	☞ *When the Sun from the Moon's Node is just without, or near the Limits of a solar or lunar Eclipse, you must examine all Circumstances closely to avoid missing an Eclipse.*
N. S. . . . Add	11		
August, Biss.	23 5 52 24	8 5 21 51	
New. September	25 2 3 23	6 9 36 20	Sun 9° ½ *past* S. Node. *Eclipse* Sun. IV.
½ Revolution —	14 18 22 2	0 15 20 7	
Full. September	10 7 41 21	5 24 16 13	Moon 6° *short* of S. Node. *Eclipse* ☽. III.

PRECEPTS for computing ECLIPSES of the SUN and MOON.

WHAT AN ECLIPSE OF THE MOON IS.

All dark Bodies, being exposed to the Sun, cast a Shadow behind them, by intercepting the Sun's Rays, and hindering the opposite Space from being enlightened. And the Earth, being a dark Body, casts a Shadow into the Space opposite to the Sun, wherein if the Moon should come, in her Course through her Orbit, she must be deprived of the Sun's Light and be so disqualified from enlightening the Earth, by Reflection of her borrowed Light, as to occasion that Appearance *which is called an* Eclipse of the Moon.

There is, besides the totally dark Shadow, which is a conic Space totally deprived of the Sun's Light, an ambient Space which is but partly deprived of his Light; that is the Space whereon the Sun's whole Body does not shine, but the Rays coming from some Part of his Body only enter and enlighten that Space more or less, according as the Place is nearer to or farther from the totally dark Shadow: This partially dark Shadow is called the Penumbra.

PRECEPTS for computing ECLIPSES of the SUN and MOON.

TO *compute an* ECLIPSE *of the* MOON.

Precept 1. At the Time of true Opposition of the Sun and Moon *(found as before)* find the *Angle which the Way of the Moon from the Sun makes with a Circle of Latitude (by Tab. P.* 392) from the Argument of *Latitude*, and hourly Motion of the Moon from the Sun. Then say,

As *Rad.* : *S. Moon's Lat.* :: *S. said* ∠ *Moon à Sun* : *S. nearest Approach of the Centers of the Moon and Earth's Shadow.*

Prec. 2. From the Table (P. 391) of *the hourly Motions and Semidiameters of the Sun*, with the Argument of the Sun's mean Anomaly, take out his Semidiameter. And, from the same Table, with the proper Argument in Eclipses, take out the Moon's horizontal Parallax and Semidiameter.

Then from the *Sum* of the horizontal Parallaxes of the Sun and Moon, *subtract* the Semidiameter of the Sun, and the *Remainder* will be the apparent Semidiameter of the Earth's *Shadow*. — To be increased by 50″ for the Earth's Atmosphere.

Prec. 3. To the Semidiameter of the Earth's Shadow, thus increased, add the Semidiameter of the Moon; and if the *Sum* of which is more than the *nearest* Approach of their Centers, (found as before) the Moon will be eclipsed at that Time; but otherwise she will not.

Prec. 4. The Moon being found eclipsed; from the *Sum* of the Semidiameters of the Moon and Earth's Shadow, deduct the *nearest* Approach of their Centers, and the *Remainder* will be the Part deficient. Now say,

As *Semidiam. of Moon* : 6 *Digits or* 360′ :: *Part deficient* : *Digits eclipsed.*

Prec. 5. From *Tab.* (P. 391) with *Arg. Lat.* and hourly Mot. Moon fr. Sun, take out the Time between the true Opposition and the mean Eclipse, or *greatest Obscuration*; which being added to, or subtracted from, the Time of the *true* Ecliptic Opposition, according as the Moon is yet short of, or past, the next *Node*, will give you the Time of the greatest Obscuration.

Prec. 6. From the Square of the *Sum* of the Semidiameters of the Moon and Earth's Shadow, in Seconds, deduct the Square of the *nearest* Approach of their Centers in Seconds of a *Degree*, the *Square Root* of what remains will be Motion of *Semiduration*, in Seconds of a Degree.

Prec. 7. If the *Eclipse* be discovered to be *above* 12 *Digits* (or total) from the Square of the Difference of the Semidiameters of the Moon and Earth's *Shadow*, in Seconds of a Degree, deduct the Square of the *nearest* Approach of their Centers, in Seconds of a Degree, the Square Root of what remains will be the Motion of Semiduration, in total Darkness, in Seconds of a Degree. Now say,

As hourly Mot. Moon à Sun in her Orb (reserved in finding the true Opposition) : *is to* 1 *Hour or* 60m *Time* :: *so is the Motion of Semiduration* : *to the Time of Semiduration.*

And :: *so is the Motion of Semiduration in total Darkness* : *to the Time of Semiduration in total Darkness.* Which being *respectively* subtracted from, and added to, the Time of the *greatest Obscuration*, will give you the Time of the *Beginning* and *End* of the Moon's Eclipse, and also of the *total* Darkness.

WHAT AN ECLIPSE OF THE SUN IS.

The Appearance, called an Eclipse of the Sun, *might properly be called an Eclipse of the Earth*; *the Earth and its Inhabitants at that Time being only deprived of the Sun's Light, while the Sun himself suffers no Defect of Light. If we consider a* Spectator *placed at the Moon in the Time of what is called an Eclipse of the* Sun, *he will behold the Moon's totally* dark Shadow, *and her* Penumbra, *pass over the Earth's Disk or Face, like as an Inhabitant of the Earth sees the Earth's* dark Shadow, *and her* Penumbra, *pass over the Moon's Disk, or Face, in an Eclipse of the Moon. Where it is to be observed, that the Sun is seen eclipsed when only the* Moon's Penumbra *falls upon the Earth*; *whereas the Moon is never seen, or said to be, eclipsed, but when she falls into the* totally dark *Shadow of the Earth. And while the Earth diurnally revolves about its* Axis, *a Spectator at the Moon will see* Countries, Cities, *and* Towns, *move upon the Earth's Disk or Face, from West to East, or from Right to Left. That as such* Spectator *at the Moon, at the Time of a* Sun's Eclipse, *sees only the Earth's enlightened Hemisphere, he will see Places emerge from behind the Western Edge of the Earth's* Disk, *and move Eastward, when the Inhabitants of such Places of the Earth see the Sun rise and move towards the West. And when such Spectator in the Moon sees the Edge of her Penumbra touch any Place upon the Earth's Disk, the Inhabitants of that Place on the Earth will see the Sun begin to be eclipsed.*

TO *compute a* general and central ECLIPSE *of the* SUN.

Precept 1. At the Time of the true *Conjunction* of the Sun and Moon *(found as before directed)* from the horizontal *Parallax* of the *Moon*, subtract the horizontal Parallax of the *Sun*, the Remainder will be the Semidiameter of the *Earth's Disk*. Likewise, to the Semidiameter of the Sun add the Semidiameter of the Moon, the *Sum* of which will be the Semidiameter of the Moon's *Penumbra*.

Prec. 2. To the Semidiameter of the Earth's *Disk*, add the Semidiameter of the Moon's *Penumbra*, and if the Sum *exceeds* the *nearest* Approach of their Centers *(found like the nearest Approach of the Centers of the Moon and Earth's Shadow, in an Eclipse of the Moon)* the Sun will be seen eclipsed in some Part of the Earth; but otherwise no Eclipse of the Sun can then happen.

Prec. 3. The Sun being found *eclipsed* in some Part of the Earth, the *Beginning*, *Middle*, and *End* of the *general* and also *central* Eclipse (with Respect to the whole Earth) may be found in like Manner as is *before directed*, for finding the *Beginning*, *Middle*, and *End* of an Eclipse of the Moon.

But to find the Places on the Earth where the *principal or particular Appearances* of an Eclipse of the *Sun* happen, may be done by an *orthographic* Projection of the Sphere, or such as would be seen by a *Spectator* placed at a very great Distance, in a right Line; joining the Centers of the Sun and Earth.

The *Beginning*, greatest *Obscuration*, and *End* of an Eclipse of the Sun, in any particular Place on the Earth, are also determined by an analytic Computation from converging Series, grounded on a geometrical Projection; (See *Dunthorne's* Practical Astronomy of the Moon, inscribed to Dr. *Long* of *Cambridge*) being a PROLIX METHOD.

TO *compute a particular or partial* ECLIPSE *of the* SUN, *by* PARALLAXES, *according to the* COMMON METHOD

Precept 1. To the apparent Time of the *true Conjunction* of the Sun and Moon, *(found as before directed)* compute the *Parallax* of the Moon from the Sun, in Longitude.

Prec. 2. To Half an Hour, an Hour or more (as the said *Parallax* is small or great) *before* or *after* the true Conjunction, according as the Moon is in the *eastern* or *western* Quadrant of the Ecliptic, compute again the *Parallax* of the Moon from the Sun in Longitude; by which Means (from the *true*) you will have the *visible* half hourly, hourly, &c. Motion of the Moon from the Sun. Now say,

As visible Motion of Moon à Sun ; *is to Time taken* :: *so is the Parallax of the* Moon *from the* Sun *in Longitude, at the Time of true Conjunction* : *to the Interval of the* true *and* visible *Conjunction.* — Which added to, or *subtracted* from, the Time of the *true* Conjunction, according as the Moon is in the *eastern* or *western* Quadrant of the Ecliptic, will give you the Time of the *visible* Conjunction of the Sun and Moon.

Prec. 3. To which Time, compute again the *true* Places of the Sun and Moon, with the *Parallax* of the Moon from the Sun in Longitude and Latitude, and so find her apparent or *visible* Place, in Respect of the Sun.

Prec. 4. To an Hour before the Time of *visible* Conjunction, compute the *visible* Longitude of the Moon from the Sun, in *Antecedence*; with her *visible* Latitude; and also to an Hour after the *visible* Conjunction, compute the visible Longitude of the Moon from the Sun in *Consequence*; with her visible Latitude. Now say,

As Sine of the visible Motion of the Moon *from the* Sun *in Longitude in those two Hours* : *is to Radius* :: *so is the Tangent of the Difference*

of

PRECEPTS for computing ECLIPSES of the SUN and MOON.

of visible Latitudes : to the Tangent of the Angle of the visible *Way of the* Moon *with the* Ecliptic *at the Time of the* visible *Conjunction.*

And, as *Radius : is to Sine of the visible Latitude of the* Moon *at the Time of the visible Conjunction :: so is the* Sine *of the Angle of the visible Way of the* Moon *with the* Ecliptic *at that Time : to the Sine of the Motion, seen from the* visible *Conjunction to the* greatest *Obscuration.*

And :: *so is the* Cosine *of that Angle : to the Sine of the* visible *Distance of the Centers of the* Sun *and* Moon *at the Time of the greatest Obscuration,* that is, their *nearest* visible Distance.

If this Distance be *less* than the Semidiameter of the Moon's *Penumbra (found as before directed)* the *Sun* will be eclipsed in that *Place* of the Earth; but otherwise not.

If the Sun be found eclipsed, from the Semidiameter of the *Penumbra* subtract the nearest *visible* Distance of the Centers of the Sun and Moon, the *Remainder* will be the Part *deficient.* — From which the *Digits* eclipsed may be found, as before *directed* in P. 398.

Prec. 5. Now say, *As the* visible *Motion of the Moon from the Sun from an Hour before to an Hour after the Time of Conjunction : is to* 2 *Hours,* or 120^{m} :: *so is the Motion seen from the* visible *Conjunction to the greatest Obscuration : to the* Interval *in Time.* — Which being *added* to, or *subtracted* from, the Time of the *visible* Conjunction (as the Moon's visible Latitude is decreasing or increasing) gives the Time of the *greatest Obscuration.*

Prec. 6. From the *Square* of the Semidiameter of the *Penumbra,* in Seconds, subtract the *Square* of the nearest visible Distance of the Centers of the Sun and Moon in Seconds, the *Square Root* of the Remainder will be the visible Motion of Semiduration in Seconds of a Degree.

Prec. 7. Now say, *As Sine of the visible Motion of the* Moon *à* Sun *in Longitude for an Hour before the visible Conjunction : is to Radius :: so is the Tangent of the Difference of visible Latitude in that Time : to the Tangent of the Angle of the visible Way of the Moon with the Ecliptic, from the Beginning of the Eclipse to the visible Conjunction.*

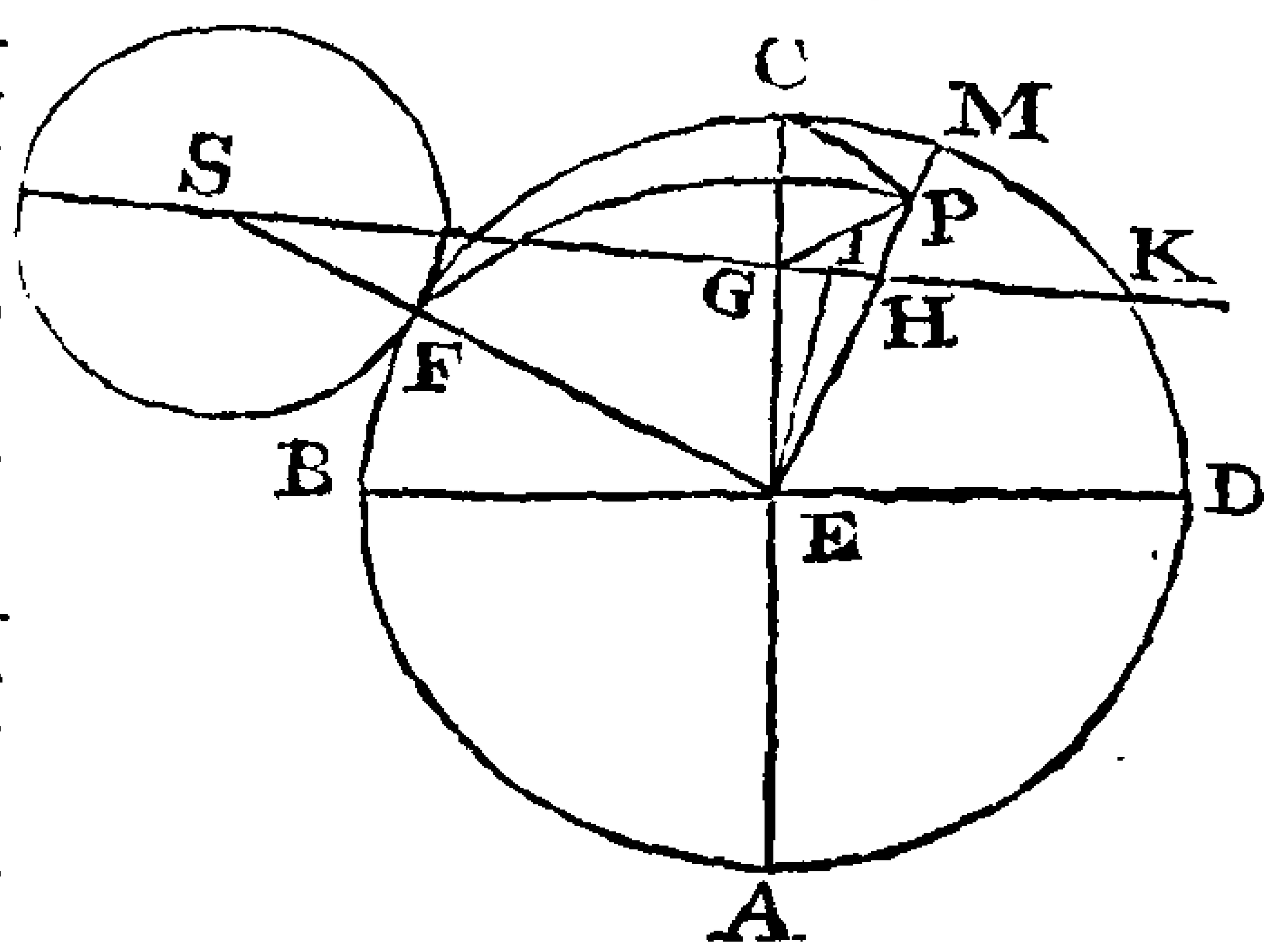
And, *As Radius : is to the* Sine *of the visible Motion of Semiduration :: so is the Cosine of that Angle : to the* Sine *of the visible Motion in Longitude from the* Beginning *of the Eclipse to the* greatest Obscuration.

Prec. 8. Likewise, As *the visible Motion of the* Moon *à* Sun *in Longitude, in the Hour before the visible Conjunction : is to* 1 *Hour or* 60^{m} :: *so is the Motion in Longitude, seen from the* Beginning *of the Eclipse to the greatest* Obscuration ; *to the Time of* Incidence — Which subtracted from the Time of greatest Obscuration, gives the Time of the *Beginning* of the Eclipse.

☞ *By the like Proportions (from the visible Longitude of the Moon from the Sun in* Consequence, *with her visible Latitude for an Hour after the* visible *Conjunction) the Time of* Emergence *and the* End *of Eclipse may be determined ; with sufficient Labour and Attention.*

To find the PLACES, on the EARTH, of the principal APPEARANCES of Solar ECLIPSES, by PROJECTION.

FIG.



IN the *annexed Fig.* the Circle ABCD represents the Earth's enlightened *Disk,* BED the *Ecliptic* thereon projected, *orthographically,* as would be seen by a *Spectator* placed at a great Distance in a right Line joining the Centers of the *Sun* and *Earth.* EC the Ecliptic *Axis,* C its Pole, P the Projection of the Earth's Pole; and SIK the Path of the Moon's *Shadow,* or her Way from the Sun projected on the *Disk.*

NOW, in the right-angled *spherical* Triangle, CMP, we have given (besides the right Angle at M) the Side CP, the Distance of the Poles of Ecliptic and Equator, and ∠ PCM = Sun's Distance from the equinoctial *Point*; from whence the Side CM, the Measure of the ∠ CEM (the Inclination of the Earth's and Ecliptic's *Axes*) is determined.

☞ *Here it is to be noted, that when the Sun is in the* ascending *Signs* ♑, ♒, ♓, ♈, ♉, ♊, *the Point* P, *the Pole of the Equator in the Projection falls to the* Right *of the* Ecliptic Axis ; *but when the Sun is in the* descending *Signs,* ♋, ♌, ♍, ♎, ♏, ♐, *the Point* P *falls to the* Left *of the* Ecliptic Axis ; *contrary to the Way it falls when the Projection is supposed to be made on a Plane parallel to the Earth's Disk, at the* Moon's *Orbit.*

The ∠ CEI, made by a *Perpendicular* to the Path of the Moon's *Shadow,* with the *Axis* of the Ecliptic is determined to be the Complement of the Angle, which the Way of the Moon from the Sun makes with a Circle of Latitude. But you must observe that this Perpendicular falls to the *Left* of the Ecliptic *Axis* when the Moon is nearer to her ascending than descending Node ; but to the *Right* thereof when she is nearer to her descending than ascending Node.

The ∠s CEM and CEI, being, as before, determined, the ∠ IEM (their Sum or Difference) the Place F on the Earth's Surface, first touched by the *Penumbra,* and where the rising Sun begins to be eclipsed in his *superior* Limb, are likewise determined, as follows.

Draw the Meridian PF ; then, in the right angled Plane Triangle SIE, are given the Sides SE, the Sum of the Semidiameters of the Earth's *Disk* and Moon's *Penumbra,* and IE, the *nearest Approach* of their Centers ; from whence the ∠ SEI is determined ; and by adding or deducting the ∠ IEM known, the ∠ SEM will be also known.

NOW, in the *spherical* Triangle PMF, on the Earth's Surface, right angled at M, the Sides PM, equal to the Sun's Declination, and FM, the Measure of the ∠ SEM, are given. Hence, you may find the Side PF, the Complement of *Latitude* of the Place F, and the ∠ MPF ; which ∠, or its Supplement to 180° (as the elevated Pole, in the Place F, is darkened or enlightened) is the Angle contained between the Meridian of the Place F, and the Meridian of the Place where the Sun is, at that Time, *vertical.* But the Longitude of the Place where the Sun is *vertical* is known by the Time ; and therefore the Longitude of the Place F, will be known. — And having determined both *Latitude* and *Longitude,* the Place itself will be known.

By the like Method you may find the Place on the Earth, where the Center of the *Penumbra* enters the Earth's *Disk,* and the Sun rises *centrally* eclipsed ; as likewise those Places where the *central Eclipse,* and *Penumbra* both quit the Earth.

And, by the same Method you may find the *Place* G, upon the Earth's Surface, under the *Penumbra's* Center, at the Time of the true *Conjunction,* when the Sun is *centrally* eclipsed in the *nonagesimal* Degree, or highest Point of the Ecliptic.

For, if EC, the *Disk's* Semidiameter, be made *Radius,* then GE, the Moon's Latitude, will be the *Sine* of the Sun's Distance from the *Vertex* of the Place G. Therefore, in the *spherical* Triangle GEP, on the Earth's Surface, the *Sides* PE, the Sun's Distance from the Pole, and GE, his Distance from the *Vertex,* and the ∠ GEP are given ; from whence are found the Side GP, the Complement of Latitude of the Place G, and the ∠ GPE, the Difference of Meridians of the Place G, and where the Sun is then vertical ; from which the Place G itself will, as before, be also known.

In like Manner, the Place of the Earth may be found, under the Center of the *Penumbra* at any given Instant of Time.

The Place H, upon the Earth's Surface, where the Sun is *centrally eclipsed* in the Meridian, may be found by only resolving the right angled Triangle EIH, wherein are given all the Angles, and the *Side* IE, to

find

To find the PLAÇES, on the EARTH, of the principal APPEARANCES of Solar ECLIPSES, by PROJECTION.

find the other two *Sides*; *viz.* IH *divided by the* Moon's *hourly Motion from the Sun will give the Difference of the Time from the Middle of the Eclipſe, when the Center of the Shadow is upon the* UNIVERSAL MERIDIAN, *or Line* HPE, *wherein the Earth's Axis is projected. It is called* Univerſal Meridian *becauſe when a* Spectator *placed in the* Moon *obſerves any Place, on the Earth's Surface comes to touch this* Line (by the Earth's diurnal Rotation) *it will be* Mid-day *to the Inhabitants of that Place.* Hence, the Longitude of the *Place* H will be known; being *equal* to the Longitude of the *Place* where the Sun is vertical, when the Center of the *Shade* is upon the ſaid *univerſal Meridian*: And the other Side HE is the *Sine* of the Sun's Diſtance from the Vertex of the Place H (making the Semidiameter of the Diſk, *Radius*) whereby the Latitude of *that Place* will be alſo known.

☞ *The Beginning, greateſt Obſcuration, and End, of an* Eclipſe of the Sun, *for any particular Place of the Earth, may be determined by algebraic Computation, and infinite Series, grounded on a geometrical Projection, ſimilar to the foregoing (as may be ſeen in* Dunthorne's Aſtronomy.) *But, as this Method is very* tedious *and* prolix, *and fitter for* Speculation *than* Practice, *we therefore omit it. And we leave it to the Computer's* PRACTICE *and* EXPERIENCE *to apply th.* plain *and* eaſy RULES *we have delivered, for computing* ECLIPSES *of the* SUN *and* MOON *in general.* See P. 260, for the Application.

NUMBER of ECLIPSES of the SUN and MOON that can happen in ONE YEAR.

THE Number of Eclipſes of the Sun and Moon in any Year cannot be leſs than *two* nor above *ſeven*. The uſual Number is *four* but very ſeldom above *ſix*.

☞ *See P. 397, for finding the Number of Eclipſes in any Year.*

If at the firſt *New* Moon in *January*, before the 11th Day, (the Number of Days Difference between the lunar and ſolar Year) the Sun be near 18 *Degrees* ſhort of the Node, the Sun will be then eclipſed, and the next Full Moon, and alſo following New Moon, will be eclipſed; *viz.* 2 Eclipſes of the *Sun* and 1 of the *Moon* will happen before the 9th of *February*, that Year. And as many will happen in the 6th Lunation after, in the ſame Order, before *Auguſt* 5, *viz.* 1 of the Sun, 1 of the Moon, and another of the Sun, in 177 Days from the former; being the Time of 6 mean Lunations. And 1 Eclipſe more of the Sun will happen at the End of 12 Lunations from the 1ſt, being the greateſt Number of *Eclipſes*, *viz.* 5 of the *Sun*, and 2 of the *Moon*, that can happen in a Year, including 13 New Moons.

Before *Jan.* 11	Ecl. Sun. *New.* Sun à ☊.	Ecl. Moon. Next *Full.* Sun à ☊.	Ecl. Sun. Next *New.* Sun à ☊.
EX. 3 Eclipſes	$11^s\,12^\circ\,30'$	$11^s\,27^\circ\,50'$	$0^s\,13^\circ\,10'$
6 Lunations +	6 4 1	6 4 1	6 4 1
3 more Eclipſes	5 16 31	6 1 51	6 17 11
6 Lunations +	6 4 1	In all 7 Eclipſes.	
1 more Eclipſe	11 20 32	☉ ☽ ☉ ○ ☽ ☉ ☉, in Order.	

But if on the firſt *Full* Moon before the 11th of *January*, the Sun from the Node be near 18 *Degrees*, as at the firſt *New* Moon, in that Month, and changing Eclipſes of the Sun to thoſe of the Moon, in the *above Example*, then there can only happen 2 *Eclipſes of the Sun*, in that Year, being the *leaſt Number*. And two Eclipſes of the Sun can only happen in a Year, when, at the firſt *New Moon* in *January*, the Sun is very near the Moon's Node; ſo that the mean or different Number of Eclipſes happen (between the greateſt and leaſt Numbers, 7 and 2) when at the firſt New Moon in *January*, the Sun á ☊ is in the middle or at different Diſtance, betwixt the Sun's eclipſed Limits, of 0 and 18 Degrees, Sun á ☊, as appears from above.

☞ Mr. Ferguſon, *in P.* 168 *of his* Aſtronomy, *not arguing from the Diſtance and Motion of the Sun from the Node, at the Time of and for Conjunction and Oppoſition, when* Eclipſes *of* Sun *and* Moon *happen (but from the Time of the Sun's Paſſage by the Node) aſſigns not the true Reaſon for the Number of* Eclipſes *that can happen in a Year. But he makes us ample Amends in his accurate Draughts, and Account of other Subjects.*

Of the PLINIAN PERIOD of ECLIPSES, and their RETURNS.

THE *Period of Eclipſes* of 223 *ſynodical* Months (diſcovered by the *Chaldeans*, and called by them *Saros*, and alſo called the *Plinian* Period, as uſed by *Pliny*) conſiſts of 18 Years, 11 Days, 7 Hours, 43 Minutes, and 20 Seconds, when 4 Leap-Years are contained; but when 5 Leap-Years intervene, it conſiſts of 1 Day leſs, or of 18 Years, 10 Days, 7 Hours, 43 Min. and 20 Seconds; very neceſſary to be noted in its Uſe.

The Addition of the odd Hours in this Period may ſhift a *ſolar* Eclipſe into Night, and a *lunar* one into Day; ſo as both to become inviſible, after a Period or two. The Sun á ☊, at the Concluſion of any Number of Periods, will ſhew whether an Eclipſe of the *Sun* or *Moon* returns, within the Limits of 18 or 12 Degrees *reſpectively*; which does not agree with Mr. *Ferguſon*'s *Account* of no Eclipſe of the Sun repeated, after 500 Years; nor yet with his 12 *Thouſand* Years Revolution, on their Return from travelling in the *Expanſe*, during that *Interval*. For ,47013° of a Deg. is what Sun á ☊ goes back in one Period; by which dividing 18°, the Quotient = 38,287 the Number of Periods, when the Moon's *Shadow* quits the Earth; which ×d by 18 Yrs ,422 in one Period = 705 Yrs ,32, *&c.* Yrs. (and not 500) when the Moon's *Shadow* quits the Earth, and travels in the Expanſe. Now, 360° ÷ 18° = 20; therefore 705,32 × 20 = 14106 Years, the Period of Returns of ſolar Eclipſes; and not 12 *Thouſand*, according to Mr. *Ferguſon.* — Again, 12° ÷ ,47013° = 25,5248 Periods, when the Earth's Shadow quits the Moon, which ×d by 18 Yrs ,422 = 470 Yrs ,217, when the Earth's *Shadow* wholly travels in the *Expanſe.* — But, 360° ÷ 12° = 30, which ×d into 470,217 = 14106 Yrs, as before, the Period of *lunar* Eclipſes, travelling in the Expanſe.

The falling back of the Sun and Moon from the ☊ in every Period, is the Cauſe of theſe Eclipſes about the *aſcending* Node happening *more ſoutherly*, at each Return; and of thoſe about the deſcending ☋ happening more northerly till they *wear* off the Earth and Moon's Surfaces, and travel in the Expanſe.

Of Antient ECLIPSES.

THE preſent *Aſtronomical Tables* are found to diſagree with the Times of antient Eclipſes, on Account of the Moon's *Acceleration* of mean Motion, requiring a conſiderable Addition to her antient mean Places, as we have illuſtrated. Therefore, the Eclipſe of the Sun predicted by *Thales*, in the 4th Year of the 48 *Olympiad*, putting an End to the Battle betwixt the *Medes* and *Lydians*, might very well correſpond with the Time of that Eclipſe by Computation; without going ſo far back with Mr. *Ferguſon*, as a *Plinian* or *Chaldean* Period, to make the Time, Appearance, and Event, agree. On which Principle of Acceleration, and no other, the Times of antient Eclipſes, in general, are to be examined, and reconciled with Obſervation.

PLURALITY of ECLIPSES.

MORE Eclipſes happen of the Sun than of the Moon; becauſe the Sun's *eclipſed Limits* are greater than that of the Moon's, as 18° to 12° Sun from ☊.

But more viſible Eclipſes of the Moon than of the Sun happen; becauſe Eclipſes of the Moon are alike ſeen from all Parts of the Earth placed next the Moon. But Eclipſes of the Sun are only viſible to that ſmall Part of the Earth (placed next the Sun) whereon the Moon's *Shadow* falls. And at the fartheſt Diſtances of the Moon from the Earth, her *Shadow* terminates before it reaches the Earth, at New Moon; and the Sun's *greateſt* Eclipſe is then called *annular*, with a bright Ring appearing round the Moon's Edge.

HISTORICAL ECLIPSES of the SUN and MOON. To be *examined.* From RICCIOLUS.

Bef. Chr. 754 *July* 5	But *April* 21, by an old Calendar, an Eclipſe of the Sun. *Rome* began to be built.
721 *Mar.* 19	Total Eclipſe of the Moon. The *Aſſyrian* Empire ended, and *Babylonian* eſtabliſhed.
585 *May* 28	Eclipſe of the Sun, predicted by *Thales.* Peace enſued betwixt the *Medes* and *Lydians.*
523 *July* 16	Eclipſe of the Moon. Followed by the Death of *Cambyſes.*
502 *Nov.* 19	Eclipſe of the Moon. Followed by the Slaughter of the *Sabines*, and Death of *Valerius Publicola.*
491 *Apr.* 25	Eclipſe of the Moon. Followed by a great Famine at *Rome*, and Beginning of the *Peloponneſian* War.*
463 *Apr.* 30	Eclipſe of the Sun. War with *Perſians*, falling off from *Egyptians.*
431 *Aug.* 3	Total Eclipſe of the Sun. A Comet and Plague at *Athens.*†

* *The Beginning of this War is here antedated* 60 *Years.*

† *This* Eclipſe *was in the* 1ſt *Year of the* Peloponneſian *War, according to* Ferguſon's *Aſtronomy.*

413	*Aug.*	27	Total Eclipſe of the Moon. *Nicias* and his Ship deſtroyed at *Syracuſe.*
394	*Aug.*	14	Eclipſe of the Sun. *Perſians* beat *Conon* in a Sea-Engagement.
168	*June*	21	Total Eclipſe of the Moon. Next Day, *Perſeus,* King of *Macedonia,* conquered by *Paulus Emilius.*
Sin. Chr. 59	*Apr.*	30	Eclipſe of the Sun. A Prodigy for the Death of *Agrippinus* by *Nero.*
237	*Apr.*	12	Total Eclipſe of the Sun. Reign of the *Gordiani* ſhort. Perſecution of Chriſtians.
306	*July*	27	Eclipſe of the Sun. Stars are ſeen, and Emperor *Conſtantius* died.
840	*May*	4	Great Eclipſe of the Sun. *Lewis* the Pious died 6 Months after.
1009	——		Eclipſe of the Sun. *Jeruſalem* taken by the *Saracens.*
1133	*Aug.*	2	Great Eclipſe of the Sun. Stars are ſeen. A *Schiſm* in the Church by two *Popes* at once.
1493	——		Eclipſe of the Sun. *Chriſtopher Columbus* drove on the Iſland of *Jamaica,* where he was refuſed Proviſions; but he affrighted the Inhabitants by Prediction of this Eclipſe; threatening them with a *Plague,* of which *that* was to be the Token; and ſo got ſupplied.

REDUCTION of ASTRONOMICAL TABLES.

EQUATIONS for the REDUCTION of *ſolar* TABLES.

Solar TABLES reduced to other Solar TABLES.	Equation of the Sun's M. Places. Eq. Sun's M. Pl.	Eq. Sun's M. An.	Eq. Sun's Apogee.		Eqn. Sun's M. Motions for 100 Yrs forward fr. 1700. Eq. Mo. Sun's M. Place.	Eq. Mo. Sun's M. Anom.	Eq. Mo. Sun's Apogee.	
Halley's Tabs, are reduced to See *p.* 120. — *Aſtron. Arcana,* or *Greenwich* Tabs, by	+0′ 28″	—3′ 50″	+4′ 18″	*Conſtant.*	—0′ 0″ 20‴	—7′ 13″ 20‴	+7′ 13″ 0‴	*variable* accordg to Yrs from 1700.
Mayer's, for *Paris* Obſervatory, by	+0 2	—6 16	+6 18		+0 14 40	—3 38 20	+3 53 0	
Mayer's, for *Greenwich* Obſervatory, by	+0 35	—5 43	+6 18		+0 14 40	—3 38 20	+3 53 0	
Aſtronomia Accurata, by	+0 10	—5 10	+5 20		—0 0 20	—1 23 0	+1 22 40	
Aſtr. Accurata Tabs. are red. to — *Mayer's* Tabs for *Paris* Obſervatory, by	—0 8	—1 6	+0 58		+0 15 0	—2 15 20	+2 30 20	
Mayer's for *Greenwich* Obſervatory, by	+0 25	—0 33	+0 58		+0 15 0	—2 15 20	+2 30 20	
See *P.* 377, for farther Reduction.								
N. B. Cut off 2 Figs to the *Right* of Secs for 100 Years Motion for Seconds for 1 Year's Motion, and multiply that Number by the Years from 1700.	The ſame Signs and Equations are conſtantly uſed for any Date or Year.				*Contrary* Signs are uſed for Years back, from 1700.			

EQUATIONS for the REDUCTION of *lunar* TABLES.

Lunar TABLES reduced to other Lunar TABLES.	Equation of the Moon's M. Places. Eq. ☽'s M. Pl.	Eq. ☽'s M. An.	Eq. ☽'s M. Ap.	Eq. ☽'s M. ☊.	Eq. ☽'s M. Mot. for 100 Yrs forward fr. 1700. Eq. Mo. ☽ M. Pl.	Eq. Mo. ☽ M. An.	Eq. Mo. ☽ M. Ap.	Eq. Mo. ☽ M. ☊.
Halley's Tabs. are reduced to See *p.* 121. — *Aſtron. Arcana,* or *Greenwich* Tabs, by	+0′ 22″	+5′ 5″	—4′ 43″	+3′ 0″	+ 3′ 5″	0′ 0″	+ 3′ 5″	+ 3′ 5″
Mayer's, for *Paris* Obſervatory, by	—4 19	—2 11	—2 8	+5 12	+ 1 55	+ 1 55	0 0	0 0
Mayer's, for *Greenwich* Obſervatory, by	+0 50	+2 55	—2 5	+5 11	+ 1 55	+ 1 55	0 0	0 0
Aſtronomia Accurata, by	+1 10	+4 10	—3 0	+1 10	0 0	0 0	0 0	0 0
Aſtr. Accurata Tabs. are red. to — *Mayer's* Tabs for *Paris* Obſervatory, by	—5 27	+4 35	+0 52	+4 2	+ 1 55	+ 1 55	0 0	0 0
Mayer's for *Greenwich* Obſervatory, by	—0 20	—1 15	+0 55	+4 1	+ 1 55	+ 1 55	0 0	0 0
See *P.* 377, for farther Reduction.								
N. B. Cut off 2 Figs to the *Right* of Secs for 100 Years Motion for Seconds for 1 Year's Motion, and multiply that Number by the Years from 1700.	The ſame Signs and Equations are conſtantly uſed for any Date or Year.				*Contrary* Signs are uſed for Years back from 1700.			

☞ OUR mean New Moon is ſooner than *Halley's* New Moon by 1m 58s. [for Time from 1700, to be allowed.
Halley's M. *New* Moon's M. An. Sun reduces to our *M. New* ☽'s An. Sun, correſpondent to 1700, beginning, by — 5′ 15″ with Eq. Mot.
—— Sun fr. Moon's *Apogee,* at his M. *New* Moon, reduces to *ours,* at our M. *New* Moon, by . . . . + 3 6 } without
—— Sun fr. Moon's ☊, at his mean New Moon, reduces to *ours,* at our mean New Moon, by . . . — 1 5 } Eq. Mot.
—— Sun fr. Moon's Apogee, reduces to ours, at the ſame Time, by . . . . + 3 10 } from
—— Sun fr. Moon's Node, reduces to ours, at the ſame Time, by . . . . — 1 0 } 1700.
—— Other *Places* reduce to *ours,* as by Equations above; *viz.* Sun's mean Anom. and alſo Mot. from 1700.

WHENCE, *it is to be generally noted, if any particular Tables reduce to ſeveral other aſtronomical Tables, in the mean Places, by certain given* Equations, *with their reſpective Signs, that any one of thoſe Tables will reduce to any other of the Tables mentioned, by changing the Signs of the Equations of the Tables to be reduced, and connecting thoſe Equations with the Signs and Equations of the Tables you would reduce to, in* one Sum, *for the Signs and Equations by which the* Reduction, *to the* required *Tables, is to be made.*

This you may *prove,* by making different Tables and their Equations *(equal to the ſame Tables)* equal to one another, and then tranſpoſing the Tables and Equations reducing them, on one Side of that Equation, and Tables required to be reduced to, on the other Side.

See Palladium 1759, P. 72, L. 8. Halley, for — 7′ 10″ Eq. ☽'s mean An and + 6′ 0″ Eq. ☽'s mean Ap. r. — 1′ 10″ and 0′ 0″.

EXAMPLES of the REDUCTION of TABLES.

To reduce to Mayer's *mean Places of the Sun for* Paris *Obſervatory.*

	Sun's Pl.	Sun's Ap.
EX. 1. *Aſt. Acc.* 1739, N. S.	9s 9° 40′ 56″	3s 8° 23′ 25″
Equation of *Place* . . .	— 8	+ 0 58
Equation of *Motion* 39 Years . . .	+ 6	+ 0 58
Mayer's mean Pl. Sun, reqd, 1739, N. S. for *Paris* Obſervatory.	9 9 40 54	3 8 25 21

To reduce to Mayer's *mean Places of the* Moon?

	☽'s Pl.	Ap.	☊.
EX. 2. *Aſt. Acc.* 1739, N. S.	5s 15° 36′ 14″	2s 23° 17′ 37	4s 13° 1′ 33″
Equat. of Place	— 5 27	+ 0 52	+ 4 2
Equat. of Mot. 39 Years	+ 0 45	0 0	0 0
Mayer's m. Pl. ☽, 1739 for *Paris* Obſerv. reqd, N. S.	5 15 31 32	2 23 18 29	4 13 5 35

Eq. Mo. ☉ + 15″ for 100 Yrs = ,15″ for 1 Yr. . . Eq. Mo. Ap. + 2′ 30″ 20‴.
39 for 100 Yrs. = 1″,5 for 1 Yr.
+ 5″,85 or 6″ for 39 Yrs. 39
+ 58″,5 for 39 Yrs.
Alſo Eq. Mo. ☽ 1′ 55″ for 100 Yrs = 1″,15 for 1 Yr.
39
So for the Reſt. + 44,85 or 45″ for 39 Yrs forwd from 1700, as above.

To reduce to Aſtronomia Arcana of Greenwich.

	Sun's m. An.	Sun's Aps
EX. 3. *Halley's* Tab. 1781, O. S.	6s 12° 19′ 55″	3s 9° 0′ 3
Subtract 11 Days Mot.	0 10 50 30	2
1781, N. S.	6 1 29 25	3 9 0 1
+	3 9 0 1	
According to *Halley,* Sun's mean Place	9 10 29 26	
Equat. Place	+0 28	+ 4 18
Equat. Mot. for 81 Yrs.	0 0	+ 5 51
According to *Aſtronomia Accurata* 1781, N. S. Sun's mean Pl.	9 10 29 54	3 9 10 40

	☽.	M. An. ☽.	☊.
EX. 4. *Halley,* 1781, O. S.	4s 9° 36′ 20	4s 15° 55′ 20	1s 10° 2′ 20
Sub. and add 11 Days Mot.	4 24 56 25	4 23 42 53	+ 0 34 57
Halley, 1781, N. S.	11 14 39 55	11 22 12 27	1 10 37 17
Equat. Place	+ 0 22	+ 5 5	+ 3 0
Eq. Mot. for 81 Years	+ 2 30	+ 0 0	+ 2 30
Aſt. Arcana, 1781, N. S. for *Greenwich* Obſerv.	11 14 42 47	11 22 17 32	1 10 42 47

F f f ☞ THUS,

☞ THUS, *the mean Places for any Time, according to one Sort of correct Tables, are reduced with Ease to the* mean Places *for that Time, according to any other Elements of mean Places and Motions. And hereby the* perpetual Variation *in composing Tables, according to different mean radical Places and Motions, is avoided. Hence also one* Set of correct Tables *of the mean Places and Motions may be rendered universally fit for Computation, by varying the Equations of* Places *and* Motion, *and improving, contracting, and correcting, the* solar *and* lunar *Equations; (with a proper Allowance made for the* Acceleration *of the Moon's mean Motion) till* PERPETUAL AND CORRECT TABLES OF THE SUN AND MOON *are properly contrived and established.*

And as a Means of arriving at so desirable an *Acquisition,* it is hereby proposed, that the *Correction of Equation of mean Place, Motion, and Acceleration of mean Motion, and also of the Equations of the mean to the true Places,* shall be published from Time to Time, as they are discovered, and found continually to approach nearer and nearer to Observation, in all Cases and Circumstances, by the indefatigable and judicious *Astronomer.* Who ought to publish (and not secret) the Observations paid for with the public Money, for the Use *wanted.*

GEOMETRICAL PROJECTION of a Lunar ECLIPSE.

TOTAL ECLIPSE of the MOON, for *Greenwich* OBSERVATORY.

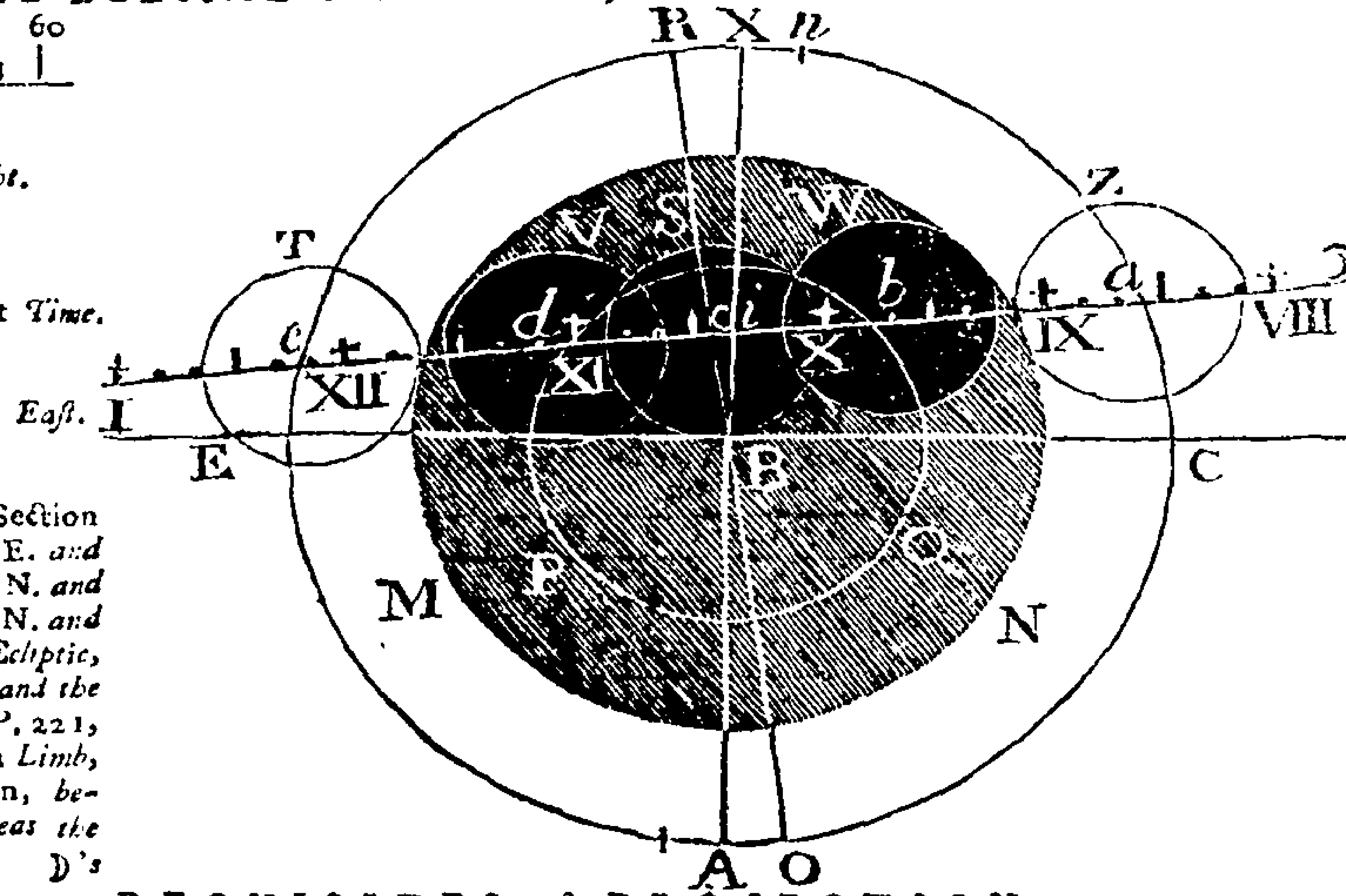
0 10 20 30 40 50 60

Scale of Mins of Deg.

On *May* 18, 1761, at *Night.*

	h	m	s	
Beginning	8	31	40	Apparent *Time.*
Immersion	9	38	42	
Middle	10	25	9	
Emersion	11	11	36	
End	12	18	38	

Digits 17. 26′. to Northward.



☽'s Way fr. the Sun to the Left.

West.

☞ *The* E. *and* W. *Parts of the* Section *of the Earth's* Shadow *respect the* E. *and* W. *Points of the* Horizon; *but the* N. *and* S. *Parts of that Section respect the* N. *and* S. *Hemispheres, divided by the Ecliptic, (the Top Part of the Cut being* N. *and the Bottom* S.) — *Mr.* Ferguson, *in P.* 221, *his Astron. says, the* ☽'s Western *Limb, in this Eclipse, after her* Immersion, *begins first to be enlightened: Whereas the* ☽'s Eastern *Limb, in Respect of the Horizon, first dips into, and first recovers from, the Earth's Shadow, as above.*

REQUISITES of PROJECTION.

Moon's *horizontal Parallax*	56′ 44″	Semidiameter of the Moon	15′ 20″	Moon's *hourly Motion*	30′ 44″
Sun's *horizontal Parallax*	10	Sum *Sem. Diam.* Moon *and* ⊖'s *Shad.*	56 22	Sun's *hourly Motion,* subtract	2 27
Sum of *both*	56 54	Moon's *Lat.* N. *subt.*	10 20	Rem. Moon's *hourly Mot.* from Sun	28 17
From which take Sun's *Sem. Diam.*	15 52	Rem. Parts *deficient*	46 2	Dif. ☽'s Semid. and Semid. ☽'s Shadow	25 42
Rem. Sem. Diam. Earth's *Shadow*	41 2			Moon's true Latitude	10 22

METHOD of PROJECTION.

FROM a Scale of Minutes of a Degree, take off with your Compasses the Sum of the Semidiameter of the Moon and Earth's Shadow, 56′ 22″, with which Extent, on the Center B, describe the outer Circle AERXCOA. Then with the Semidiameter of the Earth's Shadow, 41′ 2″, describe the inner Circle MN, for the Extent of the Earth's Shadow; and next with Dif. Moon's Semidiam. and Semid. Moon's Shadow, 25′ 42″, describe the innermost Circle PQ, on the same Center B. Draw the Ecliptic, EC, through B; and perpendicular thereto, draw AX, the Ecliptic's *Axis.*

Set off the Angle of the Moon's visible Way with the Ecliptic, 5° 43′, from X to R, to the *Left,* (because the Moon's Latitude is descending, but the Right of X when the Moon's Latitude is N. ascending to *n*) and draw RBO for the Axis of the Moon's Orbit. When the ☽'s Lat. is S. asc. / N. asc. } the *Axis* of her Orbit lies to the *Right* of the Ecliptic's *Axis.*

When her Latitude is N. desc. / S. desc. } the *Axis* of her Orbit lies to the *Left* of the Ecliptic's *Axis.*

Set off the Moon's true Latitude 10′ 22″ from B to *e,* on the *Axis* of the Moon's Orbit, being N. of the Ecliptic, (but the contrary Way, from B towards O, when the Moon's Latitude is S. of the Ecliptic.) Then through *e,* perpendicular to the Orbit's *Axis* RO, draw *e, d, c, b, a,* for the Moon's Orbit, or Way to the *Left* through the Earth's Shadow.

When the Moon's Lat. is N. asc. / N. desc. } she is *above* the Ecliptic. But Moon's Lat. being S. asc. / S. desc. } she is *below* the Ecliptic.

With the Moon's true *hourly* Motion from the Sun 28′ 17″ set off the Hours on the Moon's Orbit, to the Left, in such Manner that the Time of *Full Moon* by our *Tables,* may be placed in the Middle between *c* and *i,* in the Moon's Orbit; that is, Middle of the Intersections of the Moon's Orbit by the *Axis* of the Ecliptic and *Axis* of her Orbit. Or so as the Time of the *greatest Obscuration,* or Middle of the Eclipse, may be placed in *c.*

Lastly, with the Moon's Semidiameter 15′ 20″ describe the Circles Z, W, S, V, T, on the Centers, *a, b, c, d, e, respectively.* Let the Circles Z and T just touch the Earth's Shadow MN, without it; the Circles W, V, touch the Edges of the Earth's Shadow, within it; and the Circle S be in the Middle of the Moon's Way through the *Shadow.*

Therefore, the *Circle* { Z, W, S, V, T } represents the Moon {
- Z: When her *Eastern* Limb enters the Shadow, at the *Beginning* of Eclipse.
- W: At the Time of *Immersion,* when she is first totally eclipsed.
- S: At the Time of *greatest* Obscuration, or *Middle* of Eclipse.
- V: At the Time of *Emersion,* when she begins to be enlightened on her *Eastern* Limb, and first recovers from *total* [Darkness.
- T: When she quits the Earth's *Shadow,* at the *End* of Eclipse.

These several Times are marked on the Moon's Orbit.

⁂ Some farther represent the *Appearance* of a *lunar* Eclipse, by drawing a *horizontal* Line through the Center of the Earth's Shadow B, so that the Point of the Ecliptic C shall answer to the Altitude of the *nonagesimal Degree* at the Middle of the Eclipse, corresponding also to the Altitude of the Equinoctial of the *Place,* and culminating Point of the *Ecliptic.* And mark the Moon's Latitude in several Positions, at *Beginning, Middle,* and *End* of the Eclipse; by which the *Moon's* visible *Way* is in a *Curve-Line,* to the Left, through the Earth's Shadow.

N. B. If the Parts *deficient* be more than the *Moon's Diameter,* the Eclipse *(as above)* will be *total* with Continuance; if *equal* it will be total without Continuance; but if *less,* it will only be a *partial Eclipse* of the Moon.

☞ *A Solar Eclipse, as seen from the Earth, may be delineated,* in Plano, *in the same Manner with the above Projection of the lunar One; except that instead of the Semidiameter of the Earth's Shadow you must use the Sun's Semidiameter; and the Moon's visible Latitude, instead of the true.* And some draw a horizontal Line to correspond with the Altitude of nonagesimal Degree at the Time of Middle of the Eclipse, corresponding also to the Equinoctial's Height, and Ecliptic's meridian Altitude, and set off the Moon's visible Latitude in several Positions, at Beginning, Middle and End of the Eclipse, shewing the Moon's visible Way in a curved Line.

ANGLE of the HOUR CIRCLE (paſſing through the SUN or MOON) with the ECLIPTIC. For finding the *Parallactic* Angle of the Sun or Moon, in ECLIPSES; and alſo in all Latitudes of the Moon.

Argument. Right Aſcenſion of the SUN or MOON.

R. A Sun or ☽	♈ ♎ 0 6 Sig. 0 180 Deg. ∠ HourCirc.	Dif.	1 7 Sig. 30 210 Deg. ∠ HourCirc	Dif.	2 8 Sig. 60 240 Deg. ∠ HourCirc.	Dif.	R. A Sun or ☽
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	66 31 30	0 14	69 49 10	12 55	78 30 40	21 12	30
1	66 31 44	0 41	70 2 5	13 17	78 51 52	21 25	29
2	66 32 25	1 8	70 15 22	13 37	79 13 17	21 34	28
3	66 33 33	1 35	70 28 59	14 0	79 34 51	21 44	27
4	66 35 8	2 3	70 42 59	14 20	79 56 35	21 54	26
5	66 37 11	2 30	70 57 19	14 40	80 18 29	22 3	25
6	66 39 41	2 56	71 11 59	15 0	80 40 32	22 12	24
7	66 42 37	3 24	71 26 59	15 20	81 2 44	22 20	23
8	66 46 1	3 51	71 42 19	15 40	81 25 4	22 29	22
9	66 49 52	4 17	71 57 59	15 59	81 47 33	22 37	21
10	66 54 0	4 44	72 13 58	16 17	82 10 10	22 44	20
11	66 58 53	5 10	72 30 15	16 35	82 32 54	22 51	19
12	67 4 3	5 37	72 46 50	16 54	82 55 45	22 58	18
13	67 9 40	6 4	73 3 44	17 14	83 18 43	23 3	17
14	67 15 44	6 29	73 20 58	17 25	83 41 46	23 10	16
15	67 22 13	6 55	73 38 23	17 45	84 4 56	23 15	15
16	67 29 8	7 21	73 56 8	18 2	84 28 11	23 21	14
17	67 36 29	7 46	74 14 10	18 18	84 51 32	23 25	13
18	67 44 15	8 11	74 32 28	18 34	85 14 57	23 30	12
19	67 52 26	8 36	74 51 2	18 48	85 38 27	23 34	11
20	68 1 2	9 2	75 9 50	19 6	86 2 1	23 37	10
21	68 10 4	9 26	75 28 56	19 17	86 25 38	23 41	9
22	68 19 30	9 50	75 48 13	19 32	86 49 19	23 44	8
23	68 29 20	10 14	76 7 45	19 47	87 13 3	23 46	7
24	68 39 34	10 38	76 27 32	20 0	87 36 49	23 49	6
25	68 50 12	11 2	76 47 32	20 12	88 0 38	23 50	5
26	69 1 14	11 25	77 7 45	20 26	88 24 28	23 51	4
27	69 12 39	11 47	77 28 11	20 38	88 48 19	23 54	3
28	69 24 26	12 11	77 48 49	20 50	89 12 13	23 53	2
29	69 36 37	12 33	78 9 39	21 1	89 36 6	23 54	1
30	69 49 10		78 30 40		90 0 0		0
R. A Sun or ☽	∠ HourCirc. 5 11 Sig. 150 330 Deg.	Dif.	∠ HourCirc. 4 10 Sig. 120 300 Deg.	Dif.	∠ HourCirc. ♋ ♑ 3 9 Sig. 90 270 Deg.	Dif.	R. A Sun or ☽

Conſtruction. As Radius : S. Ecliptic Obliquity :: Coſ. R. A. from next Equin. Point, :: Coſ. ∠ Hour Circle with the Ecliptic.

Example. *To find the Angle of Hour Circle with the Ecliptic to* 65° R. A. *from the next equinoctial Point?*

	Logarithms.
As Radius . .	10.0000000
To S. 23° 28′ 30″	9.6002636
So Coſ. 65° . .	9.6259483
To Coſ. 80° 18′ 29″ ∠ Hour Circle required.	9.2262119

Moon's Diſt. fr Ecliptic, or viſ Conj. to Orbit Conj. or Midd. Ecl. ☉.

Ar. Viſ. Lat. ☽.

Viſ. Lat. ☽.	Diſt. fr. *viſ.* Conj. to *Mid. Ecl.* ☉.
° ′	′ ″
0 1	0 5
2	10
3	15
4	20
5	25
10	51
15	1 17
20	1 43
25	2 9
30	2 34
35	3 0
40	3 25
45	3 50
50	4 15
55	4 41
1 0	5 7
5	5 32
10	5 57
15	6 24
20	6 49
25	7 14
30	7 39
35	8 4
40	8 30
45	8 55

Lat. ☽	Diſt. above
N S asc	—
N S def	+

USE.

As viſ. hourly Mot : 60m :: Diſt. fr. Mid. Ecl. in *Mot.* : Diſt. in *Minutes* of Time.

Viſible Conjunction of *Sun and Moon*, as ſeen from the Earth's Superficies, always differs from the Time of *true Conjunction*, as ſeen from the Earth's Center, except when they are conjoined in the nonageſimal Degree; when the true and viſible or apparent Time is the ſame. — Hence, if the true Conjunction falls to the *Eaſtward* of the nonageſimal Degree, the *Moon*'s Place is advanced by her *Parallax of Longitude*, when the viſible Conjunction is before the true. But if the true Conjunction falls to the *Weſtward* of the *nonageſimal Degree*, the *Moon*'s Place is retarded by the *Parallax in Longitude*, and the viſible or apparent Conjunction of *Sun* and *Moon*, then follows the Time of the *true Conjunction*, very neceſſary to know in computing ſolar Eclipſes.

PRINCIPLES of PROJECTION of a *Solar* ECLIPSE, *Geometrically*.

A *Plane* being conceived to touch the *Moon*'s Orbit in a Point where a *Line* (at right Angles to the ſaid *Plane*) interſecting the ſaid *Orbit*, connects the Centers of the *Earth* and *Sun*; and an *infinite* Number of ſtraight Lines being ſuppoſed to paſs from the Sun's Center, through the ſaid *Plane* of the Earth's Periphery, to the Axis thereof, and likewiſe to the *Axis* of the Ecliptic, and the Path of any *Vertex*, the ſaid ſtraight Lines will, *orthographically*, project the *Earth's Diſk*, its *Axis*, the *Axis of the Ecliptic*, and *Path of the Vertex*, on the aforeſaid Plane.

See Flamſtead's Doctrine of the Sphere, P. 27.

If the Sun be in the Equinoctial, the Paths of the *Vertices* (deſcribed by the Rotation of the Earth's Surface) will be projected in *ſtraight Lines* upon the ſaid Plane; but if the *Sun* has Declination, thoſe Paths will be projected in *Ellipſes*, upon the ſaid Plane.

The Tranſverſe-Diameter of the Ellipſis, repreſenting any Path, is equal to double the right Line of the Diſtance of the ſaid *Vertex* from the Pole; that is equal to twice the Coſine of the Place's Latitude. But the Conjugate is equal to the Difference of the right Sines of the Sum and Difference of the Diſtances of the Path and *Sun* from the Pole. That is equal to the Sine Compl. of the *Sun*'s Declination added to the Co-latitude of the Place leſs the Right Sine of the Difference of the Complement of the Sun's Declination, and Co-latitude of the Place.

The Tranſverſe Diameter lies at right Angles to the Earth's *Axis*, and the Conjugate coincides with it.

Of the MOON's PARALLAXES.

1. If the Diſtance of the *Moon* from the Point aſcending or deſcending of the Ecliptic, be leſs than her Altitude, ſhe has then no Parallax in Latitude, which never happens but in ſuch Latitudes where the *Moon*'s Orb or Ecliptic are vertical Circles.

2. If the *Moon*'s Diſtance from the Point aſcending or deſcending be juſt 90°, then a vertical Circle interſects the Ecliptic at right Angles, and then is no Parallax of Longitude but only of Latitude.

3. If the Vertical paſſing through the *Moon*'s Center fall on the Ecliptic, at oblique *Angles*, then there is Parallax in Longitude and Latitude.

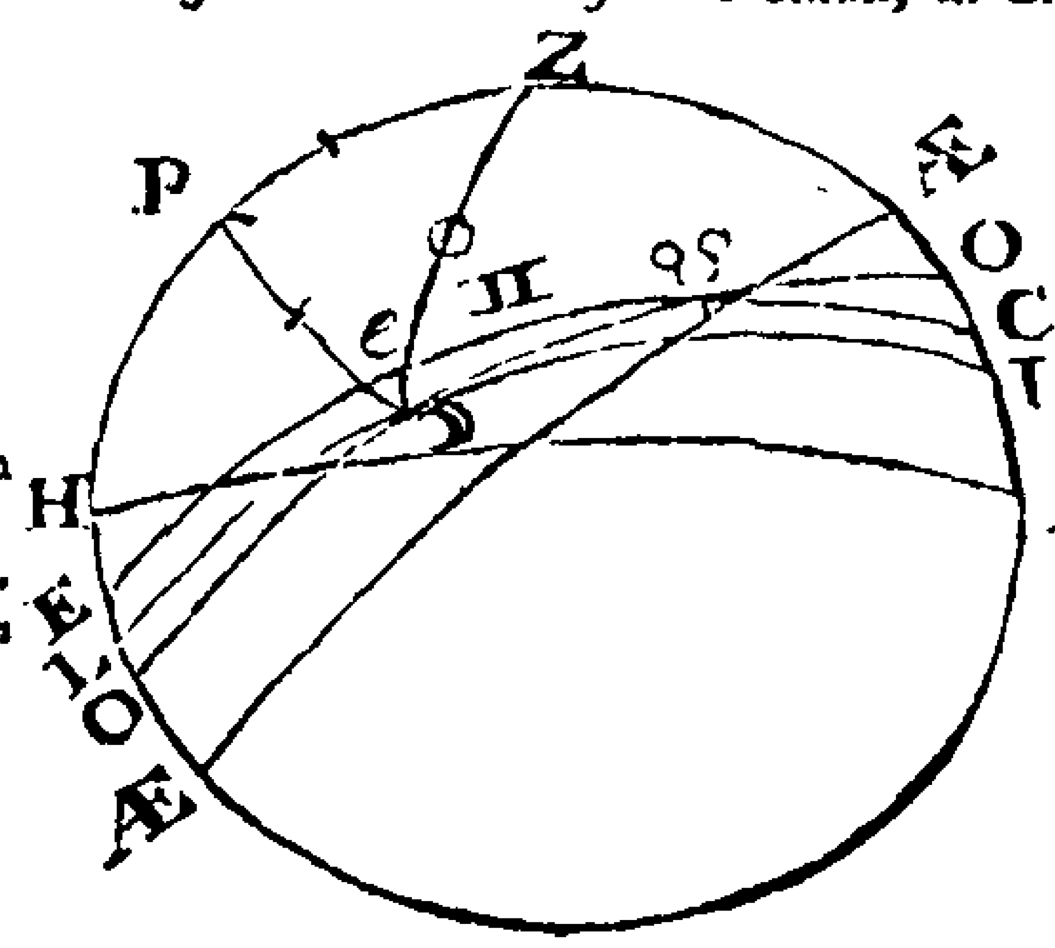
4. To all Places on the Earth having above 28° 46′ 20″ North Latitude, the *Moon*'s Parallax is *Southerly*, and is depreſſed below her true Place, according as ſhe is Eaſt or Weſt of the 90°. — *Theſe Parallaxes are neceſſary to be known in the Computation of ſolar Eclipſes.*

EXAMPLES of *computing* the PARALLACTIC ANGLE, according to DIFFERENT METHODS. By D. COWPER.

1717, *September* 17d 9h 58m 20s, *apparent Time, observed* Emersion *of an Occultation of* Aldebaran, *at* Crane-Court, London.

Sun's Longitude	♎ 2°38′		0″
Right Ascension	182	24	57
Time from Noon in Degs.	149	35	0
R. Asc. *Med. Cœli*	331	59	57
Moon's Long. in *Ecliptic*	♊ 5	38	0
—— Latitude S.	4	38	33
—— Declination N.	16	42	15
—— Right Ascension	64	34	32
Angle at the *Pole*	92	34	35
Moon's Zenith-*Distance*	78	33	59
Angle of Position, at ☽'s Center, or ∠P☽Z	39	21	26
Angle of *Parall.* Lat. and Circ. Decl. ∠P☽L, the less	80	9	10
Or ∠P☽L Supplement the greater	99	50	50
Parallactic ∠, or ∠P☽L — ∠P☽Z, *required.*	60	29	24

P, the *North Pole.*
Z, the *Zenith.*
HH, the *Horizon.*
ÆÆ, the *Equator.*
EC, the *Ecliptic.*
LL, Parallel *Latitude.*
O☽O, Moon's *Orbit.*
☽, Moon's *Orbit-Place* with 4° 38′ S. *Latitude.*
PZ, Comp. Lat. 38° 28′ 0″.
P☽, Moon's Distance *from Pole* 73° 17′ 45″.
Z☽, Moon's *Comp. Alt.* 78° 33′ 59″.
∠☽PZ, 92° 34′ 35″.
☋ descending *Node* ☽.



∠ZeC, parallactic ∠ at the *Ecliptic*; being the Angle of a vertical Z☽ with the Ecliptic EC.
∠Z☽L, Parallactic ∠ at the *Moon*; being the Angle of a *vertical* Z☽ with a Parallel of *Latitude* LL.

By the *Universal* METHOD.

Meridian Angle	69°24′		26″
Altitude *Med. Cœli*	26	56	34
Moon's Azimuth from N. or ∠PZ☽	77	28	25
Parallactic ∠ ZeC	60	38	14

To find the parallactic Angle at the Moon, or ∠Z☽L, *from the parallactic Angle at the Ecliptic* ZeC?

As *Cos.* ☽ *Lat.* 4° 38′ 33″ : *Rad.* :: *Cos. parallactic* ∠ *at* ☽ 60° 38′ 14″ *above* : *Cos.* 60° 31′ 52″, *parallactic Angle at the Moon, required.*

By the 90th DEGREE.

Medium Cœli in Ecliptic	♒	29°	53′	59″
Altitude 90th Degree		33	26	10
Longitude 90th Degree	0	4	35	14
Moon from 90th Degree	2	1	2	46
Moon Zenith Distance		78	33	43
Parallactic ∠ ZeC		60	32	2

According to D. COWPER's short METHOD.

1737, *Feb.* 18d 2h 25m 9s *Ap. Time,* Beginning. Sun Eclip. observed at *Fleetstreet.*

Sun's Longitude	♓	11°	6′	55″
—— R. Ascension	3	42	34	48
Time fr. Noon in Degrees		36	17	15
R. Asc. *Med. Cœli* — 360°		18	52	3
Moon's Ecliptic Long.	♓	11	10	44
—— Latitude N.		0	37	40
—— Declination S.		6	48	11

☽'s Right Ascension	342°	23′	56″
∠ at the Pole	36	28	7
Moon's Zenith Dist.	66	7	41
∠ Position at ☽	23	52	54
Angle of Paral. Lat. and Circ. Decl.	67	41	5
Diff. *parallactic* Angle	43	48	11

According to UNIVERSAL METHOD. For same Time.

Meridian Angle	67°	51′	20″
Altitude *M. Cœli*	46	31	10
Moon's Azim. fr. S.	40	11	48
Parallactic Angle	43	48	20

According to 90th DEGREE. For same Time.

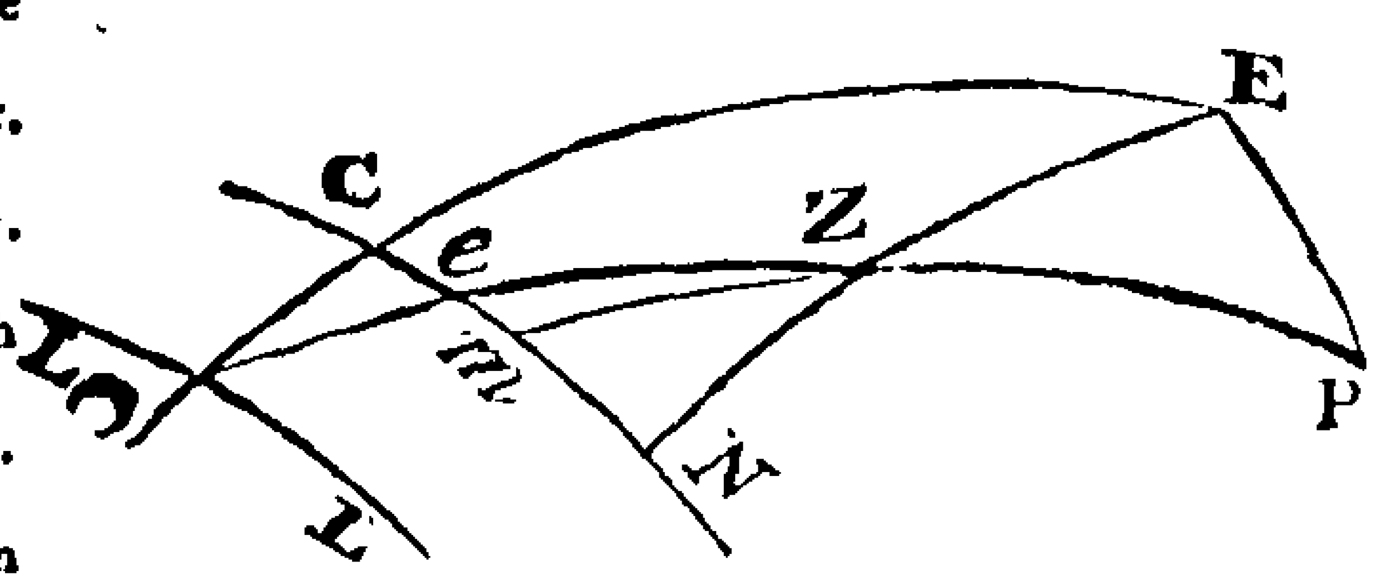
Med. Cœli in Ecl.	0s	20°	26′	4″
Altitude 90th Deg.		50	24	20
Longitude 90th Deg.	1	10	6	25
Moon fr. 90th Deg.	1	28	55	41
Moon's Zenith Dist.		66	7	56
Parallactic Angle		43	48	12

EXPLANATION of the foregoing DIFFERENT PARALLACTIC ANGLES.

☞ When the Moon is in or *near* the *Ecliptic,* or near ♋ or ♑, with Latitude, the *parallactic* Angle at the *Ecliptic* Z*em* will be sufficient to answer the *Purpose.*

But if she be near ♈ or ♎ the parallactic Angle at the Moon must be used; the *Difference* between both which Angles being then considerable.

P, the N. Pole of the World.
E, Pole of the Ecliptic.
Z, the Zenith.
CN, Part of the Ecliptic.
C☽, Lat. ☽ South.
N, the Place of 90th Deg. Ecliptic.
L☽L, a Parallel of Lat.
P*m*, the Meridian.
∠P*m*N, the Meridian Angle.



ZE = Altitude 90th Deg or Dist. of Zenith fr. Pole of Ecliptic.
∠C*m*Z also the Merid.
∠Z*em*, or C*e*☽, the *parallactic* ∠ at the *Ecliptic.*
∠C☽*e*, the Compl. of *parallactic* ∠ at the Moon, that a Vertical Z☽ makes with a Circle of Latitude E☽.

For, As *Cos. Lat.* C☽ : *Rad.* :: *Cos. parallactic Angle at Ecliptic,* C*e*☽ : *Cos. parallactic Angle at the Moon,* of Z☽L, *viz.* to C☽*e,* required, according to the above Proportions by D. *Cowper.*—The true *parallactic* Angle, at all Times, being the Angle of a Vertical and Parallel of Latitude, or the Complement of the Angle that a Vertical makes with a Circle of Declination, *viz.* Complement of ∠E☽Z being ∠*e*☽L; agreeing with Mr. *Dunthorne*'s Remark in his *Astronomy,* P. 63.

From whence follows this QUERE. If E☽, a Circle of Latitude, cut the Ecliptic CN, and Parallel of Latitude LL, both at right Angles, why should not the alternate Angles ZeN, Z☽L, respecting the same Parallels, cut by the *vertical* Circle Z☽ be the same, or the parallactic Angle at *Ecliptic* and at the *Moon,* be the same?

☞ *It is observed by one of our Correspondents, (a very judicious* Mathematician *and* Astronomer) *that he never met with any Author who taught the true Method of representing the Appearances of Eclipses, &c. nor ever saw them truly described in any* Almanac *or* Ephemeris, *for the* British *Dominions, except in the late* Weaver's Ephemeris.

This *Correspondent* computed the *parallactic Angle,* and the Moon's visible Latitude, in several Positions, at the *Beginning, Middle,* and *End* of some *Eclipses,* for the Island of *Antigua,* that he might truly *delineate* the Manner of their *Appearance* there which (by Reason of the Ecliptic *transiting* the Zenith once in every 24 Hours) is quite different to what happens here in *England,* both with Respect to the *Position* of the Moon's Face, and the *visible Curve* she describes.

The

The solar Eclipse, happening the 18th of *February*, 1737, has been computed by the *operose Method* delivered in *Leadbetter's Uranoscopia*, from P. 147 to 153; *viz.* for finding the *Meridian* Angle, *culminating* Point, 90th Degree, *&c.* in the *Moon's Orbit*. And likewise that *Eclipse* was computed, for the same *Place*, with these *Requisites* in the Ecliptic; but the last Computation came much nearest to the Observation. And you may observe in the *Examples* of the Use of Dr. *Halley's Tables*, (*d* and *d* 2) that the 90th Degree, and *parallactic* Angle at the Moon, are both taken in the *Ecliptic*; though the Moon had almost 5° of *Latitude*.

It is likewise evident, that as the *Ecliptic* is a *fixed Circle*, (not changing its *Inclination*, and Place of *Intersection* with the Equinoctial, like the Moon's Orbit) in which the Sun *constantly* appears, and is that Circle to which all the *Longitudes* and *Latitudes* of the Planets are computed, and referred (being the *Standard* for determining the Moon's *visible* Longitude and Latitude) therefore the *other Method* of computing the *parallactic* Angle made by the Intersection of a *Vertical* and the *Moon's Orbit*, is rejected; as being both tedious and inaccurate.

PRECEPTS of lunar COMPUTATION.

TO find the Moon's true Place, from the mean Time given, when one of her Limbs passes the Meridian, her observed Right Ascension at that Time, (having no Parallax) and Distance of her lower (or upper) *Limb from the* Vertex.

In the Year 1725, *December* 5, the *Western* Limb of the Moon was observed by Dr. *Halley* to pass the *Meridian* of the Royal Observatory at *Greenwich*, at 9h 8m 5s, mean Time, its observed Right Ascension being 42° 26′ 15″, and Distance of the *lower Limb* from the *Vertex* 34° 9′ 15″; *Required from thence the Moon's true Place in the Ecliptic, and also her Latitude?*

EXAMPLE.

By *Halley's* Tables of the Moon's Ecliptic Longitude ♉ 15°42′ 34″
(See P. e. 1.) Her Latitude North 1 39 57

By same *Tables*. Moon's horizontal *Parallax* then 0 59 43
Which Parallax, at any Time, is also had fr. an *Ephem.*

Half + 1/16 of that Half is the Moon's *horizontal Diameter* 0 32 50
The observed Dist. of the Moon's lower Limb fr. *Vertex* 34 9 15
To which add Refraction + 36

Ap. Dist. ☽'s lower Limb fr. *Vertex*, clear of *Refraction* 34 9 51

	Com. Log.	
Now, As Radius	10.0000000	
To S. hor. Parallax 59′ 43″	8.2397998	0021 Lo. Log.
So S. Dist. à Vert. 34° 9′ 51″	9.7494008	2506 Ar.Com.L.S.
To S. ☽ Par. in Alt. 33′ 32″	7.9892006	2527 L. L.

This Parallax subtracted fr. ap. Dist. ☽'s lower Limb from the *Vertex*, clear of Refraction . . ° ′ ″ 0 33 32
Remains true Dist. Moon's lower Limb fr. Vertex 33 36 19
Subtr. from which the horizontal Sem. ☽ — 16 25
Rem. the true Dist. Moon's Center from *Vertex* 33 19 54
The Compl. of Lat. of Observatory, added to which 38 31 30
Sum, The true Dist. ☽'s Center from N. Pole 71 51 24

	Com. Logs.	
Now, As Sine ☽'s true Dist. à Pole 71° 51′ 24″ co.	0.0221481	9778 Log. Sine
To Radius . .	10.0000000	
So S. hor. Diam. ☽, 32′ 50″	7.9800345	2617 L. L.
To. S. ☽'s hor. Diam. in R. A. 34′ 33″	8.0021826	1.2395 L. L.
		0° 34′ 33″

To the observed R. A. of the Moon's Western Limb 42°26′ 15″
Add the Moon's horizontal Semi-Diameter in R. A. 0 17 16
Sum, is the true R. A. of the Moon's Center 42 43 31

Now, From the Moon's R. A. 42°43′ 31″ } Quest. XXX.
And her Distance from the N. Pole 71 51 24 } P. 228.
Her *Ecliptic* Longitude will be ♉ 15 42 12 } *by the*
Latitude North 1 38 37 } *Observation.*

Longitude } less than by Tables { 0′ 22″ } the Error of Com-
Latitude } { 1 20 } putation.

The horizontal Diameter of the Moon is to her Diameter in Longitude, as *Cosine* of the Moon's Latitude to *Radius*.

And her horizontal Diameter is to her Diameter in right Ascension, as the *Cosine* of her Declination is to *Radius*.

The *Seconds* of a Degree (in Tab. P. 391) answering to the Moon's Distance from the Vertex, and also to her Distance from her *Apogee*, being added to the Moon's *horizontal* Diameter, will give her apparent Diameter, which, increased in the respective foregoing Proportions, will give her apparent Diameters in *Longitude* and *right Ascension*.

☞ When the Moon's *Eastern* / *Western* Limb touches the Meridian, *subtract* / *add* her Semidiameter in right Ascension or Long. *from* / *to* her right Ascension or Longitude of the Limb observed, for the right Ascension or Longitude of her Center.

REMARK on Dr. *Halley's* TABLES. See the END of his *Preface-Writer's* PREFACE.

" *It appears from Dr.* Halley's *Papers, that both in* computing *the* " right Ascension *of the Moon's Limb, and finding the Longitude of her* " *Center from Observation, he constantly used the apparent, instead of the* " *true, Semidiameter of the Moon; and consequently from the Beginning* " *of the Table* Lunæ Meridianæ, &c. *to the latter End of the Year* " *1725, from the* New *to the* Full *Moons, while the* Western *Limb was* " *observed, the computed right Ascensions of that Limb are set down too* " backward; *and during the Remainder of the Month, while the* Eastern " *Limb was observed, the* computed *right Ascensions of that Limb are* " *set down too* forward.

" *And from the Year* 1725, *the* Longitudes *of the Moon's Center de-* " *duced from the Observations of the* Western *Limb are set down too for-* " ward, *and those from the Observations of the* Eastern *Limb too* back- " ward.

" *This Error is not considerable, and seldom exceeds* 15″; *therefore in* " *common Cases it may be neglected. — But if any one undertakes to correct* " *the Moon's mean Motion, or to new model the Equations, it will be ne-* " *cessary to correct the* Errors *in the* Abacus, *or Table, by the Excess* " *of the Moon's apparent Semidiameter in right Ascension, or Longitude,* " *above her* horizontal *Semidiameter of the like* Denomination."

To find, according to HALLEY'S METHOD, *the Time when the Moon's* Eastern *Limb passed the* Meridian *of* Greenwich-*Observatory, on* December 28, 1745?

EXAMPLE.

Take a *Plinian* Period back, which to *December* 18, 1727, is 18 Years, 10 Days, (because it contains 5 Leap-Years) on which Day, in the *Tabs. Lunæ Meridianæ*, the Moon's Eastern Limb was observed to pass the Meridian at 13h 45m 21s, mean Time.

But 18 Yrs. 10 Ds. want 7h 43m 20s of a complete Period; in which Time the Moon's mean Motion is . . 4° 14′ 22″
And the Meridian passes over an Arc of the Equator equal to this Arc of mean Motion, in . . . } 16m 55s
Subtract which therefore from the Time of *Observation*, and there remains . . . . } Mean Time. 13h 28m 26s
The near Time of the Passage of the Moon's *Eastern* Limb over the Meridian of *Greenwich* Observatory, *required*.
But, the Moon's computed Long. to this Time is ♌ 6° 43′ 8″
Her Latitude N. 3 49 24
In the last Column of *Halley's Abacus*, *Tab. Lunæ meridianæ*, the *Error* of Computation for *December* 18, 1727 is — 3′ 1″
Therefore, *add* which to the computed Longitude, and you have the correct Longitude for the Time ♌ 6° 46′ 9″
Hence, the right Ascension of the Moon is found 130 12 38
Which *increased* by her true Semidiameter in R. A. 17 18
Gives the R. A. of the Moon's *Eastern* Limb 130 29 56
To Sun's mean *Long.* at the given Time 288°25′ 2″
Add an Arc answerable to the above M. Time 13h 28m 26s . . . . } 202 6 30
Sum, is the right Ascension of the *Meridian* 130 31 32

Which right Ascension is *past* the Moon's *Limb* by an Arc of 1 36

☞ *The* Supplemental Equation-Tables, *at Beginning of this* Work, *used with the Eccentricity of the Moon's Orbit, or 2d Equation of her Apogee, are for* Trial *and* Comparison *of Computation, by other Methods; in Order for making Improvement in the* Use *and* Number *of lunar* Equations, *by different Methods.*

Different METHODS of observing the LONGITUDE.

This *Arc* the Meridian passes over in about 6s ½ *Time*, which *subtracted* from the Time given, would *leave* the Time of the Moon's *Transit* correct, over the Meridian *sought*, but for the Moon, increasing her right Ascension after her Limb passed the Meridian, and thereby diminishing her Distance from the same.

To allow for which *add* 4″ to the Arc of Distance and it becomes	0° 1′ 40″
Which Arc the Meridian passes over in	7s T.
Subtract which from the Time given	13h 28m 26s
There *remains* the mean Time, *correct*, of the Moon's *Eastern* Limb passing *Greenwich* Meridian, according to Tables	13 28 19
Observed by Dr. *Bradley*	13 28 21

Of HALLEY's METHOD *of determining the* LONGITUDE *by* OBSERVATION.

1. HE observes the mean Time of Approach of the Moon's Limb to a *fixed Star*.

2. The mean Time, and angular Distance of the Moon's Limb from a *fixed Star*, nearly in the same Parallel of Latitude.

3. The mean Time, and angular Distance of the Moon's *Limb* from the Sun's *next* Limb in her first and last Quarter.

All observed under a *distant* Meridian from *Greenwich* Observatory.

And by assuming a mean Time at *Greenwich* Meridian, to which his *astronomical* Tables are adjusted, (by repeated *Trials*) till it corresponds with the respective mean Time of the apparent Observations, made under a distant Meridian, he determines the *Difference* of Longitude: Being the *Degrees* answerable to the *Difference* between the *assumed* mean Time at *Greenwich* Observatory, and the mean Time under the distant Meridian, where and when the respective *Phænomenon*, or Appearance, is observed.

This he *effects* (as may be seen at the Beginning of his Tables) by computing the Sun's Longitude and the Moon's Longitude corrected, and Latitude to the assumed Time at *Greenwich* with the Moon's *horizontal* Parallax to that Time.

Then the mean Time, in *Degrees*, when the Observation was made, being added to the Sun's mean Longitude, at *Greenwich*, will give the right Ascension of the distant Meridian, nearly.

And by the Moon's *Parallax*, he gains the *parallactic Angle*: Whence from the Moon's true Distance from the *Vertex* (her apparent Semidiameter being given) he determines her Parallax in *Altitude*, *Longitude*, and *Latitude*, (according to *Rules* in P. 234) and thence her visible Distance and also of the *Star*, from the *Vertex*, (allowing for *Refraction*) and apparent Place of her Limb or Center, in *Longitude*; so as to correspond with the *visible* or apparent *Contact*, or *angular* Distance, of the *Moon* and *Star*; or Distance of the Moon and Sun first given.

Of DE LA CAILLE's METHOD *of determining the* LONGITUDE, *by* OBSERVATION.

This celebrated great Astronomer, proceeds according to the *Reverse* of Dr. *Halley*'s *Method*; from the apparent or visible to the true Distances of the Objects, observed.

He uses, for his Aid, *l'Almanac nautique*, wherein are computed the Distances of the Moon's Limb from a given *fixed Star* at *Paris*, to every Hour of the Night for each astronomical Day of the Year, under that Meridian; from whence the true angular Distances of the Moon from the same Star, to any other *intermediate* Time at *Paris*, are had by a *single* Proportion.

To which there is *annexed* the true Time of the Moon's Passage by the Meridian of *Paris*, and the Log. of her horizontal Parallax in *Seconds* of a Degree, at that Time.

Also the true Distance of the Moon's *Limb* from the Sun's next *Limb* are set down, for every Hour of the Day; with the Sun's Distance from each Pole, and Log. of the Moon's *Parallax* for each Day, at Noon, in the said *Almanac nautique*. — With the *Logarithms* for proportioning the Distances of the Moon and Star, or Moon and Sun, for Times between the Hours; with other *auxiliary Tables*, for facilitating the Operation; as may be seen in *De la Caille*'s *Ephemerides*, from 1755 to 1765.

1. *He finds the true Time of Observation under a distant Meridian from* Paris, *from Altitude of a* Star, *and Distance of the* Eye *from the Earth's Surface* (allowing for Refraction) *the true Distance of the Star from the Pole being also given, on a certain Day, when the true Time of its Passage by the Meridian of* Paris *is known, and to be* nearly *estimated for a distant Meridian, and the* contrary.

2. *He reduces the visible Altitude of the Moon and Star, observed under a distant Meridian, to the true Altitudes, at the Moment of their* angular *Distance taken.*

3. *He corrects the observed, or visible angular Distances of the Moon and Star to the true Distance; being an Error caused by Refraction.*

4. *He corrects the visible Distance observed to the true angular Distance of the Moon and Star, allowing for the Effect of the Moon's Parallax. — On which he remarks on a particular Case of the Moon and Star being in the same Vertical.*

5. *Then from the* Result *of these Operations, he finds the true Distance of the* Moon *and* Star, *as seen from the Earth's Center, for the Place of Observation, and true Time given; then proportioning for the true Time, to the same true Distance of the Moon and Star under* Paris *Meridian, the Difference of the Time of Observation, and Time at* Paris, *(when the Moon and Star have the same true Distance) reduced to Degrees, will be the* Difference of Longitude, required; *being a more* direct, *but a more tedious and* difficult Method *than Dr.* Halley's; *notwithstanding the Helps from the* Almanac nautique, *in proportioning the same Distance of the Moon and Star, or of the Moon and Sun, and a* Table *of Logarithms to the Distances from the* Zenith; *answering to Refractions, &c.*

Of observing the LONGITUDE *at* SEA, *by the* MOON's THEORY.

M. DE LA CAILLE takes Notice, in the *Introduction* to his EPHEMERIDES, from 1755 to 1765, that the Moon and Star's *Altitudes*, and their *Distance* from each other, are with Doubt, or Difficulty, taken near enough for Use. That, as the Moon's Motion is but 13° ± in 24 Hours, affording an Arch of about 2′ of a Degree, moved over by the Moon in 4 Minutes of Time to a Degree Difference of Longitude, an *Error* of 3′ of a Degree resulting from the Observation, and Computation of the Moon's *true Place*, under a distant Meridian, will create an Error of about 1 Degree and a Half in the Difference of *observed Longitude*. Who thinks we cannot be certain of the Longitude nearer than to 2 Degrees, on Account of the many contingent Obstacles in the Observation; however skillful the Observer and however accurately and well contrived his Instruments may be, with which he observes.

He also advances that in the several *Circumstances* entering into the *Observation* and *Computation* of the Longitude at Sea, that the Sum of the *unavoidable Errors* thereby are not less than 5′ of a Degree. Who enumerates several *Causes* of Error, in taking an Observation of the Altitudes and Distance of the Moon and some Star, by a Quadrant of *Reflection*. 1. *The defective Division of the Instrument.* 2. *The Difficulty of ascertaining the Parallelism of the Glasses in the Use of the Instrument.* 3. *The Difficulty of ascertaining the Contact of necessary Images and Parallelism, by the Diameters of Objects, in a Glass magnifying not more than* 3 *or* 4 *Times.* 4. *The Difficulty of adjusting the Images of Objects when we would measure their angular tr. Dist.* 5. *The Motion of the Ship interrupting our Attention to the Objects.* 6. *About* 1′ *of a Degree Error, from the best lunar Tables, though rectified by Observation, in computing the Moon's true Place.* Who farther adds, that Persons, having been at Sea, may have seen, that two Observers taking the Sun's Altitude at Noon, with a good Quadrant of Reflection, well rectified, shall differ 5, 6, 7, or 8 Minutes of a Degree, in rough Weather. That in the *finest* Weather and *calmest* Sea, no two Persons will agree in ascertaining the *exact* Latitude; but will differ at least, 3 or 4 Minutes of a Degree, which are the *Limits* assigned to Observations made at Sea, when the greatest Care is taken and the best Instruments are used in observing.

Of observing the LONGITUDE at SEA, by the MOON's THEORY.

ON WHICH WE REMARK:

THAT if a Mean of the *Latitudes, Altitudes, &c.* taken by several Observers, of the same, at the same Time, be determined, it will come *very near to Truth.* For though it is possible one Observer may mistake, it does not follow that he must do so; because it is known, that several unavoidable Errors, lying a different Way, compensate rather than encrease one another. And by a Repetition of Observation, by one, or more Observers, using the same Methods, we may come near the Truth by taking a Mean of two or more Longitudes determined. And hence the Difference of *Longitude*, by the Moon's Place, observed under a distant Meridian, at a given or determined Time, compared with the corresponding Time, when the Moon has the *same Place* under a first Meridian, from correct Tables, will be very near the Truth, and extremely interesting for correcting a Ship's Longitude in long Voyages.

Therefore the Discovery of the Difference of Longitude, betwixt Greenwich *and the Place of Observation, is Nothing more than the Difference of Time turned into Degrees, (allowing 15′ of a Degree to 1 Minute of Time) betwixt the Times of the Moon having the same computed Place at* Greenwich, *as that observed under a distant Meridian; allowing for* Parallax *and* Refraction, *at the Place of Observation, for reducing the Moon's apparent to her true Place.*

It is observed that the *Moon's Altitude* in the Night can be but imperfectly taken, though the Sky be then very clear; because the Horizon of the Sea is then seen but very *confusedly*; unless the Moon be very near the Horizon. This arises from the Moon's reflected Light upon the Surface of the Water, between the Eye and Horizon; the Sea and ill polished Glasses making the Effect unequal. A *Train* of Images are painted in the *Vertical* of the Moon, where Light hinders to distinguish the Horizon of the Sea beyond it; which however is always near the End of that *Train*, except when the Moon is near the Zenith. But when the Moon is very *low*, or near the Horizon, *(between 5 and 15 Degrees Altitude)* this reflected Light is confounded with the Horizon of the Sea, and then is the Time you may take her Altitude the *most exactly* and fit for the *Purpose of the Longitude*, according to *De la Caille*'s *Method*.

A small *Cloudiness* or Thickness at the Horizon is reckoned another Obstacle to taking the Moon's true *Altitude*; because we thereby see the Extremity of the Horizon but very imperfectly, in considerable Altitudes of the Moon.

When the Moon passes to the Meridian more than 2 Hours after Sun-Rising, or before his Setting, her *Light* is then too feeble to determine, exactly, her Meridian Altitude. And when the Moon is covered with Clouds, in the Time of her Passage to the Meridian, there is Nothing to be done that Day. All which *Inconveniences* must be reduced to the proper *Opportunity* of observing the Longitude, or else they render the *Result* of the Observation extremely doubtful.

In this *Method*, besides the Moon's Altitude, it is necessary to have, as exact as possible, the Distance of the Moon from a near *Star*, that we may succeed without having 3 or 4′ *Error*; and we must also have as exactly as possible the Altitude of the *given Star*, one of the brightest, *not in the Vertical of the Moon*, for avoiding the Inconveniencies of its *Reflection*, that frequently occasions it to be seen on the Horizon of the Sea In taking an Observation of its Altitude 7 or 8 *Minutes of Error* therein, will not be of much Concern in finding the *Hour Angle*, or Time of Observation. There are but *few Cases* wherein an *Error* in the Star's Altitude of 7 or 8 *Minutes* of a Degree will cause an Error of 15 Minutes of Time in the *Hour Angle*, or 3 Degrees and ¾ in the *Longitude.* But, there are a great *Number of Cases* where an *Error* of near 15 *Minutes* of a Degree in the Star's Altitude, will not make 1 Minute Error of Time in the *Hour Angle*, that we seek; and consequently not above 15 Minutes of a Degree Error in the Longitude or 5 or 6 *English* Leagues.

ACCOUNT *of a* PAMPHLET *pretending a* DISCOVERY *of the* LONGITUDE.

IN the Year 1710 there was a small Pamphlet, (which is fallen into our Hands) printed for *D. Midwinter*, at the *three Crowns* in *St. Paul's Church-Yard*, intitled A *New* and *Easy* METHOD to find the LONGITUDE at *Sea.* Which was from the Observation of the Altitudes of the Moon (though not of her Limb, but of her Center by Guess) in the same *Vertical* with a *fixed Star*, taken by two Observators, with the Altitude of a second *fixed Star*, taken at the same Time, by a *third Observator*; from whence the Moon's *Ecliptic Place* and *Latitude* were determined, together with the *Latitude* of the Places and Time of *Observation* (but without any Allowance for *Parallax* and *Refraction*, whereby the Operation became altogether *erroneous.*) To which observed Time and Place of the *Moon*, the Time correspondent was also found in the Tables to the *same Place*, in a blundering *Way*, and thence, *erroneously*, the Difference of Longitude between the Meridian of the *Tables*, and Meridian of *Observation.*

OUR METHOD of *determining* the MOON's true PLACE under a *distant* MERIDIAN.

☞ *By taking the* Altitude *of the Moon's upper or lower* Limb, *on the same* Vertical *with a noted* fixed Star, *whose Altitude is then taken (allowing for* Parallax *from an Ephemeris, and* Refraction) *at a given Time, in a given* Latitude, *you may, from thence, determine the Moon's* true Longitude *and* Latitude, *which will be of Use in determining the Distance of the Meridians, between the Place of Observation and that Meridian, for which correct* astronomical Tables *of the* lunar *Places are adapted. For the Difference of Time, in Degrees, between the Time of the Moon's true Place observed under a distant Meridian, and the Time of the* same true Place *computed from Tables suited to the first Meridian, will be the* Difference *of* Longitude between those two Meridians.

But the Meridian Altitude of one of the Moon's Limbs, *and Time when it touches the Meridian being taken, (allowing for* Refraction *and* Parallax) *and the Time before or after which a noted* fixed Star *transits the same Meridian, whose Meridian Altitude is truly ascertained, will give the Moon's true Place, as seen from the* Earth's *Center, from her visible Place seen from the Earth's* Surface, *the soonest of any Method (because there is no* Parallax *in right Ascension of the Moon, on the Meridian) and thence you will have the Difference of* Longitude *from the computed Time to the same true* lunar Place.

EXAMPLE of computing the DIFFERENCE of LONGITUDE from GREENWICH.

By observing the MOON's *true* PLACE *under a distant* Meridian.

Supposing that to the Westward *of* Greenwich, *on* July 14^d 1^h 20^m *in the Morning,* 1764, *equal Time, the Moon's true Place (as seen from the Earth's Center) be found from her visible Place (as seen from the Earth's Surface)* ♒ 4° 39′: Required, *from thence, the Place's* Longitude *from* Greenwich, *where and when that Observation is made?*

By *De la Caille*'s *Ephem.* ☽'s Pl. reduced to *Greenwich.*

1764, *July* 13, Noon | 23° ♑ 28′
14, Noon | 7 ♒ 23
Dif. 14° 55′, ☽'s diurnal Mot.

23° ♑ 28′ }
4 ♒ 39 } Dif. 11° 11′. Say, As 14° 55′ : 24^h :: 11° 11′ : 18^h *fere*, from the Noon of the 13th.

Hence it is 18^h past Noon, at *Greenwich* on the 13th *astronomical* Day of *July*, or at 6 in the Morning, on the 14th *civil* Day, 1764, when the Moon has Longitude ♒ 4° 39′, nearly.

But to determine the Difference of Longitude correctly, compute the Moon's true Place for 1764, *July* 13^d, 18^h, at *Greenwich*, and repeat the Operation, till the *equal* Time at *Greenwich* is found correspondent to ♒ 4° 39′ Long. ☽; then the *Difference* between the computed Time at *Greenwich* and *July* 13^d 13^h 20^m Time of the Observation, under the distant Meridian, turned into Degrees, will give the *correct* Difference of West *Longitude* from *Greenwich*, required.

By first XI. Equa. marked C, and *correcting Tab.* 1764, *July* 13^d 18^h *Greenwich*, Moon's Place . . . ♒ 3° 59′ 6″
1764, *July* 13^d 13^h 20^m under dist. Merid. observed ♒ 4 39 0

Moon's Pl. at *Greenwich* short of Place observed 39 54
1764, *July* 13^d 19^h, *Greenwich*, Moon's Pl. computed ♒ 4 33 43
Hourly Motion of the Moon 34 37

Say, 34′ 37″ : 1^h :: 39′ 54″ : 1^h 9^m 10^s above 18^h, or

1764, 13^d 19^h 9^m 10^s Time at *Greenwich* }
1764, 13 13 20 0 Time under distant Meridian } Moon's Pl. the same, *viz.* ♑ 4° 39′.

Dif. *sooner* 5 49 10 under dist. Meridian.

Answering to 87° 17′ 30″ W. Lon. fr. *Greenwich*, req. *So for the Rest.*

A NEW METHOD of making a LUNAR EPHEMERIS.

To estimate the MOON'S PLACE, *and of making a lunar* EPHEMERIS.

LET the Moon's Place be computed 4 Times in a *Month*, at *least*, (though 6 Times will be better) *viz.* on the Noon of the *Syzygies*, and *Quadratures*, being the *extreme Limits* of Motion.

If $4^s\ 1^\circ\ 5'$ be *added* to the Moon's *true Place*, for any one Day, it will give her true *Longitude* for any other Day, within 12 or 15′ at most, after 4326 Days (being 11 Years, 309 Days, or 12 Years wanting 56 Days) are elapsed.

Therefore, look into a *correct Ephemeris* for 12 Years before. And if you would know the Moon's true Place on the *1st of January*, *seek* her Place for the 27th of *February*, 12 Years before; to which add $4^s\ 1^\circ\ 5'$, and the *Sum* will be her true Longitude on the *1st Day of January*, required, after 12 Years, within about 12 or 15′ *(at most)* of her computed Place by good *astronomical Tables*. But on some Days of the Year, after 4326 Days elapsed, the *Difference* will be Nothing.

EXAMPLE.

	☽ Pl. Noon.	Lat.	☽'s Pl. *De la Caille.* Noon.	Lat.
1752, *Feb.* 16, O.S. or 27, N.S.	♌ 14° 27′	4° 52′		
	+ 4 1 5			
☽'s Pl. 1764, *Jan.* 1. *Greenw.*	♐ 15 32		♐ 15° 47′	4° 35′

Proceeding thus, from Day to Day, with the Places found in an *old Ephemeris*, still adding $4^s\ 1^\circ\ 5'$, and writing against the *Sums*, the respective Days answering thereto, successively, you will have a *new Ephemeris* of *lunar* Places, answering nearly to the *Truth*.

Parker's Ephemeris has been the *best* for this Purpose; because Dr. HALLEY condescended, annually, to assist that *Ephemeridist* in his Computations; especially in the lunar Places; as the late Mr. *Henry Beighton*, F. R. S. then Author of the *Ladies Diary*, observed in 1738, who was personally acquainted with both those Gentlemen.

As the Moon's true Place may differ from that computed, for the Days of the *new Moon*, *Quarters*, *&c.* some few Minutes, may proportionably be *added* to, or *subtracted* from, the computed Places, found after *each Interval*, according as the *Case* may require, which will determine the *Moon's Place* to a desired Accuracy, without a *new Computation*.

N. B. The foregoing Method (communicated by a *Friend*) of estimating the Moon's Place is proposed for *Trial*, and making a farther Improvement.

☞ *See* Palladium 1758, *P.* 48, *for a* Method *of determining the Moon's true Place after a* Plinian *Period (of 18 Years, 11 Days, &c.) and also her* Latitude.

See also Palladium 1759, *P.* 68, *for a* Method *of determining the* Lunations *and Moon's Rising and Setting, after a* Plinian *Period.*

To find the near Time of the Moon's Rising, (or a Planet's) in a given Latitude?

Enter the *Table* of oblique Ascensions in Time, as in *Leadbetter's* II. Vol of *Astronomy*, (proper to the Latitude of the Place) and with the Moon's or Planet's Longitude and Latitude, at the estimate Rising, take out the *oblique Ascension* in Time, from which deduct the Sun's right Ascension in Time at the estimate Rising, and the Remainder more or less 6 Hours, (according as it is less or more than 6 Hours) will be the near Time of Moon's (or a Planet's) Rising, in the Morning, required.

To find the near Time of the Moon's (or a Planet's) Setting, to a given Latitude?

Enter the *Table* of *oblique Ascensions*, in Time, (proper to the Latitude of the Place) with the *opposite* Sign and Degree of *Longitude*, and *contrary Latitude* to what the Moon (or Planet) has at the Time of *Setting*, and take out the *oblique* Descension in Time agreeing thereto, from which take the Sun's right Ascension in Time, and the Remainder, more or less 6 Hours, (according as it is less or more than 6 Hours) will be the Time of the Moon's (or Planet's) Setting after Noon, required.

Since the Difference of *oblique Ascensions* of 1 Degree (in our Latitudes) in a Sign of *long* Ascension, as ♋, ♌, ♍, ♎, ♏, ♐, is but 6^m of Time, at most, if the Moon's Longitude be within 10 or 12′ of *Truth*, which it will *seldom* exceed, and for the most Part be less, it *occasions* but about 1^m *Error* in the Time of *Rising* and *Setting*. And as for 3 or 4′ of Latitude (which perhaps may sometimes happen) that will not cause above Half a Minute's Variation, at most, in her *Rising*.

But, if she be in the Signs of *short Ascension*, as in ♑, ♒, ♓, ♈, ♉, ♊, the Difference of *oblique Ascension* of 1 Degree, will not, sometimes, amount to 2 *Minutes* in Time. *Consequently*, should her Longitude vary as above, there will not (by *this Method* of Computation) be *Half* a Minute Difference *(at most)* from the true *Rising* and *Setting*.

In Computations of this Kind, it is necessary to be careful in reducing the Moon's Place and right Ascension, and Sun's right Ascension, for the Time given, to those for the estimate Time of her *Rising* and *Setting*; or (in repeating the Operation) for the last found Time.

☞ *In the foregoing Operations,* Parallaxes *and* Refractions *are not considered.*

Of the MOTION of COMETS.

THE Reverend STEPHEN BOLTON, M. A. and *Rector* of *Stalbridge, Dorsetshire*, has obliged us with *several* of his *curious Remarks* and *Improvements*, on the Motion of *Comets*. The BASIS on which he founds his Improvements, and to which he refers all his Computations, depends on the *angular* Motion of the Earth round the Sun, from the first to the last Observation of the Comet. To *exemplify* which, he has given several Schemes of the angular Motion of the Earth round the Sun, in different Positions of different Comets observed.

His UNIVERSAL METHOD *of subtracting or adding the Angles, found at the Sun, to and from other Angles which the Earth describes round the Sun, so as to correspond with the Angles observed in different Positions of the same* Comet, *or to reconcile an Agreement among one another, must infallibly prove the* Data *to be true, and when they may be depended upon.*

Moreover, if the *parabolic Trajectory* of a Comet be found, very nearly, to answer the Observations at the Earth, it is very reasonable to conclude *(he says)* that the *Velocity* of that Comet, in its true *elliptic Orbit*, in and about the *Perihelion*, and Perihelion-*Distance* itself, will be *very nearly* the same, as in the fictitious *parabolic Curve*.

And, if so, then Nothing more is *wanting* (he says) but to find such *Semi-Transverse* to the Comet's elliptic Orbit, (or *periodic Time*, the one giving the other) as may *exactly* correspond with all the Observations of the Comet taken; and which (he says) may be effected by *Trial*.

☞ *See our easy and short Method of finding the true from the mean* Anomaly *of a* Planet *or* Comet. P. 96.

In taking Observations of the Altitude of a *Comet*, and *fixed Star*, in the same *Vertical*, either above or below the *Comet*, Mr. *Bolton* projects the Light from a *dark* Lanthorn up a fine *silver Wire* playing in Water for a *vertical* Line.

The *Altitude* of the *Comet* (allowing for Refraction) Time of Observation, and Latitude of the Place, being given, the Star's angular Distance from the Meridian is also given. Whence the Comet and Stars Azimuth from the North, the Star's Angle of Position, by a *Vertical* and Circle of Declination, the Star's Altitude, and consequently, the Difference of Altitudes, the Difference of right Ascension of Comet and Star, and Co-Declination of the Comet; and the Longitude and Latitude of that Comet, are found.

☞ *Two Observators, taking the Altitude of the* Comet, *and* fixed Star, *on the same* Vertical, *either above or below the* Comet, *at the same Time, on the same* Azimuth, *may spare the foregoing* astronomical *Operation.*

EXAMPLE of lunar COMPUTATION. According to D. C.

By *Halley's Tables.*	SUN and MOON's PLACES computed. C.		
	s ° ' "	s ° ' "	s ° ' "
Sun's mean *Longitude*	6 12 52 52	6 12 52 52	6 10 56 46
Sun's *Equation*	— 1 56 6	6 8 54 16	6 8 54 16
Sun's true *Longitude*	♎ 10 56 46	0 3 58 36	0 2 2 30
Sun's mean *Anomaly*	3 4 41 37	An. Arg. to mean Long. Sun.	An. Arg. to true Long. Sun.
By *Royal Astronomer.*	☽'s Longitude. s ° ' "	☽'s Apogee. s ° ' "	☽'s Node. s ° ' "
1732	3 21 40 39	5 9 45 34	8 27 47 49
September 22	8 11 44 41	. . 29 31 23	. 14 2 0
H. 11	. . . 6 2 21	. . . . . 3 4	. . . . 1 27
37m . . 28s	. . . . . 20 34	 11	 5
			— 14 3 32
Mean Motions	0 9 48 15	6 9 20 12	8 13 44 17
Annual Equations	+ 11 23	— 25 56	+ 9 20
☽ 1. equated	0 9 59 38	6 8 54 16	8 13 53 37—
Apogee 1. equated —	6 8 54 16	☽'s Ap. 1. equated.	0 10 2 12 ☽
Mean Anomaly	6 1 5 22	6 1 5 22	3 26 8 35 [1st Ar. Lat.
6 Equations	+ 0 15	0 4 5 0	2. An. Arg.
Anom. 7 Equat.	6 1 5 37	5 27 0 22	Evec. fr. ⊙ tr. Pl.
Elliptic Equation	+ 0 7 45	+ 0 4 7	½ M. Eq. ☽ Cen. + [6 less Eq.
Anom. 8 Equat.	6 1 13 22	5 27 4 29	Arg. of Evec. fr. ⊙ [tr. Pl.
Evection Equation	— 0 4 12		

		Nº.	Argum^ts.	Equations. —	+
Anom. 9 equated	6 1 9 10				
Variation-Equation	— 1 14		s ° '	' "	' "
True Anomaly	6 1 7 56				
Apog. 1 equated +	6 8 54 16				
☽'s Orb. Long.	0 10 2 12	II.	0 2 2	0 26	. . .
Reduc. + *Eq* ☊ = 22"	+ 5 53	III.	9 26 53	. . . .	0 38
		IV.	1 20 46	. . . .	0 47
☽ in *Ecliptic*	♈ 10 8 5	V.	5 29 10	. . . .	0 1
Observed	♈ 10 8 27	VI.	9 1 42	2 25	. . .
Error	— 0 22	VII.	2 22 18	. . . .	1 40
Omitting the 7th Equation according to *Newton.*	Error — 2' 2"	An. 9.	6s 1°9'10	2 51	3 6
		An. Ar.	0 2 2 30	—	—2 51
By *Halley's Tables,*	Error — 5' 2."	☽ à ⊙	5 29 6 40	6 less Eq.	+0 15

ARGUMENTS of EQUATIONS and CONCLUSIONS.	s ° ' "
Mean Anomaly of the ☽	6 1 5 22
2. Mean *Arg.* Ann. or 2. mean Long. 2. ⊙ à ☽'s Apogee . .	0 7 57 12
Mean *Evection*	5 23 8 10
½ Mean *Equation* of the ☽'s Center + Diff. 6 Equations . .	+ 4 7
Arg. of *Evection*, correct, from Sun's mean Place . . .	5 23 12 17
Evection-Equation to this Argument	— 0 9 40
Evection-Equation to Arg. Evec. (from ⊙ true Pl.) 5s 27° 4' 29" . .	— 0 4 12
Diff. = Equation of *Evection* from quadruplicate *Ratio* of Sun's Dist. .	5 28
Newton's greatest *second* Equat. of ☽'s Center	— 2 25
Greatest *Equation* of ☽'s Center, from *tripl. Ratio* of Sun's Dist. resulting . .	3 3
According to *Mayer,* 3d + 4th Equation . .	3 0
According to *R. Astronomer,* 6 + 7 Equation	4 6

These last Equations, *viz.* their *Sum,* are to the *Evection-Equation,* respectively at a *Maximum,* as 3. *Eccentricity* of the Earth's Orbit to its *Semitransverse.* (*See* P. 376.)

☞ *The above is designed as a* PROOF, *that the Sum of the* 6 *and* 7 *Equations, at the Beginning* OF THIS WORK, *is* = 4' 6", *at a Maximum, deduced from the reciprocal triplicate Ratio of the Sun's Distance, agreeing with* 5' 28" *Equation, by Tables, according to the quadruplicate or* 4th *Power of the Sun's Distance inversly.* — For, as the generated Equations are directly as the Indices of the reciprocal generating Powers of the Sun's Distance, Say,

As 3 Index : 4' 6" Equat. :: 4 Index : 5' 28" Equat. *by Tables,* as above. Q. E. D.

EXAMPLE of COMPUTATION. According to Mr. MAYER's fupplemental EQUATIONS. *See P.* 97.

To find the SUN and MOON's PLACES 1739, *February* 12d 3h 39m 22s½ true Time, or 3h 54m 10s mean Time, *for the Meridian of Paris* OBSERVATORY.

	Sun's Longitude.	Apogee of the Sun.	☽'s Longitude.	Apog. ☽.	☊ afcend.
	s ° ′ ″	s ° ′ ″	s ° ′ ″ Acceleration 0 1	s ° ′ ″	s ° ′ ″
1739	9 9 40 54	3 8 25 22	5 15 31 28	2 23 18 28	4 13 5 35
February 12 3h 54m 10s	1 12 22 58 7 24 2 13	7 0 0	6 26 35 6 1 38 49 29 44	4 47 26 50 15	2 16 38 24 7
⊙ Equation	10 22 13 29 + 1 21 9	3 8 25 29	0 14 15 8 — 8 55	2 28 6 59	2 17 9
		7 13 48 0	⊙ M. Anom.	9 16 8 9 — 14 32	4 10 48 26 — 7 16
	10 23 34 38 Correct Long. + 8	Diam. Sun 3229 Hor. Mot. 231	0 14 6 13 + 5 50 3	9 15 53 37 — 8 55	4 10 41 10 I. 8 9 50 40
⊙ Long. fr. Equx. Precef. Equx.	10 23 34 46 — 14	98802 + 3	0 19 56 26 35 24	XI. 9 15 44 42	☽ à ⊙ 1 26 57 Doub. 3 23 54
Tr. Long. ⊙ fr. Eqx.	10 23 34 32	98805 ⊙ à ⊖.	0 20 31 50 — 4 30	☽ à ⊙ 1 20 31 27 Doub. 3 11 2 54	II. 7 14 3
☽ à ⊙	1 20 40				
An. ☽ 2. ☽ à ⊙	9 16 8 3 11 20	Lefs Equations.	0 20 27 20 Long. ☽ fr. Eq.	XII. 5 25 18 12	South Lat. 4 50 1 South Lat. 6 36
			Prec. Eq. — 14	+ 5 56 54 — 0 6 41	South Lat. 4 56 37 Or Tot. Lat. ☽ S.
			0 20 27 6 Tr. Long. ☽ fr. Eq.	+ 5 50 13	
				XIII. 1 26 21 40	XI. 56 9 XII. + 38 XIII. — 10

	Sun's Longitude.	Lefs Equations. —	Lefs Equations. +
Arg. I.	7 13 48 . . .	8′ 1″	
II.	10 25 8 . . .	. . .	0′ 31″
III.	7 27 32 . . .	. . .	0 52
IV.	1 9 0 . . .	. . .	1 8
V.	10 11 24 . . .	0 54	
VI.	0 7 28 . . .	. . .	0 41
VII.	6 20 46 . . .	21	
VIII.	2 2 20 . . .	. . .	36
IX.	5 17 14 . . .	20	
X.	4 4 32 . . .	3 7	
	Total —	12 43	3 48
	+	3 48	
	—	8 55	

Eq. Par. ☽			56	37
Hor. Diam. ☽			30	53
Equat. Precef. Equinox			—	14
Long. Sun from Equinox	♒	23°	34′	32″
Long. ☽ from Equinox	♈	20	27	6
Latitude ☽ South		4	56	37
Long. ☽ obferved	♈	20	27	15
Latitude obferved		4	56	45
Error in Longitude		—	0	0
Latitude		—	0	8

Correction of the Longitude of the SUN and SUN's Diftance from the EARTH. According to Mr. MAYER.

Argument. MOON from the SUN.

☽ à ⊙.	Sig. 0. Long.	Sig. 0. Dift.	Sig. 1. Long.	Sig. 1. Dift.	Sig. 2. Long.	Sig. 2. Dift.	Sig. 3. Long.	Sig. 3. Dift.	Sig. 4. Long.	Sig. 4. Dift.	Sig. 5. Long.	Sig. 5. Dift.	☽ à ⊙.
	+	+	+	+	+	+	+	—	+	—	+	—	
°	″	Parts.	″	Parts.	″	Parts.	″	Parts.	″	Parts.	″	Parts.	°
1	0	5	5	4	9	3	10	0	9	3	5	4	30
6	1	5	6	4	9	2	10	1	8	3	4	5	21
11	2	5	7	4	9	2	10	1	8	3	3	5	16
16	3	5	7	3	10	1	10	1	7	4	2	5	11
21	4	5	8	3	10	1	9	2	6	4	2	5	6
26	4	4	8	3	10	0	9	2	6	4	1	5	1
	—	+	—	+	—	+	—	—	—	—	—	—	
☽ à ⊙.	Long.	Dift.	Long.	Dift.	Long.	Dift.	Long.	Dift.	Long.	Dift.	Long.	Dift.	☽ à ⊙.
	Sig. 11.		Sig. 10.		Sig. 9.		Sig. 8.		Sig. 7.		Sig. 6.		

A TABLE and EXAMPLE *new modelled*, for USE, (the TRUTH of *Investigation* and *Construction* being proved.) According to MISCELLANEOUS TRACTS. Whereby you may reduce a COMET's LONGITUDE from the Perihelion in a *parabolic* Orbit, to the Longitude from the Perihelion in an *elliptic* Orbit; by the Difference of Motion in those Orbits.

Comet from Per.	Min. of Deg.	Corresp. common Log.	For Log. of *Comet* fr. Sun.	*Comet* from Per.	Min. of Deg.	Corresp. common Log.	For Log. of *Comet* fr. Sun.	*Comet* from Per.	Min. of Deg.	Corresp. common Log.	For Log. of *Comet* fr. Sun	*Comet* from Per.	Min. of Deg.	Corresp. common Log.	For Log. of *Comet* fr. Sun.
o	—	—	—	o	—	—	—	o	+	+	—	o	+	+	—
1	30′	1.4770	5.8200	41	836′	2.9220	9.0006	81	152′	2.1827	9.4777	121	3547′	3.5499	9.7516
2	60	1.7770	6.4220	42	836	2.9229	9.0195	82	206	2.3139	9.4851	122	3675	3.5653	9.7602
3	90	1.9533	6.7735	43	836	2.9232	9.0378	83	261	2.4170	9.4924	123	3806	3.5805	9.7690
4	119	2.0778	7.0242	44	836	2.9228	9.0555	84	318	2.5021	9.4996	124	3941	3.5956	9.7781
5	149	2.1740	7.2178	45	835	2.9217	9.0727	85	376	2.5750	9.5067	125	4078	3.6105	9.7874
6	179	2.2521	7.2759	46	832	2.9200	9.0894	86	435	2.6386	9.5138	126	4220	3.6253	9.7971
7	208	2.3178	7.5095	47	827	2.9176	9.1056	87	496	2.6951	9.5207	127	4364	3.6399	9.8070
8	237	2.3745	7.6250	48	821	2.9145	9.1215	88	558	2.7470	9.5275	128	4513	3.6545	9.8172
9	266	2.4242	7.7269	49	814	2.9107	9.1369	89	622	2.7936	9.5342	129	4667	3.6690	9.8278
10	294	2.4683	7.8178	50	806	2.9061	9.1520	90	688	2.8373	9.5409	130	4825	3.6835	9.8387
11	322	2.5074	7.8998	51	796	2.9007	9.1666	91	754	2.8776	9.5475	131	4989	3.6980	9.8500
12	349	2.5431	7.9747	52	784	2.8945	9.1808	92	823	2.9152	9.5540	132	5158	3.7125	9.8618
13	376	2.5760	8.0437	53	772	2.8874	9.1947	93	892	2.9506	9.5605	133	5332	3.7269	9.8740
14	403	2.6058	8.1074	54	758	2.8795	9.2083	94	963	2.9837	9.5670	134	5512	3.7413	9.8866
15	430	2.6331	8.1666	55	743	2.8708	9.2215	95	1036	3.0154	9.5734	135	5698	3.7557	9.8997
16	455	2.6583	8.2217	56	726	2.8610	9.2344	96	1110	3.0455	9.5797	136	5890	3.7701	9.9132
17	480	2.6816	8.2735	57	708	2.8500	9.2469	97	1186	3.0742	9.5860	137	6088	3.7845	9.9273
18	505	2.7032	8.3222	58	688	2.8378	9.2592	98	1264	3.1016	9.5923	138	6207	3.7991	9.9419
19	529	2.7233	8.3682	59	667	2.8243	9.2712	99	1343	3.1279	9.5986	139	6513	3.8138	9.9571
20	552	2.7420	8.4116	60	645	2.8095	9.2829	100	1423	3.1531	9.6050	140	6730	3.8286	9.9729
21	575	2.7594	8.4528	61	621	2.7932	9.2943	101	1505	3.1774	9.6113	141	6974	3.8435	9.9893
22	596	2.7755	8.4921	62	596	2.7754	9.3055	102	1588	3.2008	9.6176	142	7219	3.8585	10.0064
23	617	2.7906	8.5295	63	570	2.7557	9.3163	103	1673	3.2236	9.6239	143	7475	3.8736	10.0242
24	637	2.8046	8.5652	64	542	2.7338	9.3270	104	1761	3.2457	9.6302	144	7743	3.8889	10.0427
25	657	2.8176	8.5994	65	512	2.7095	9.3374	105	1850	3.2671	9.6366	145	8024	3.9044	10.0620
26	676	2.8297	8.6320	66	482	2.6827	9.3477	106	1941	3.2879	9.6430	146	8316	3.9199	10.0822
27	694	2.8410	8.6634	67	450	2.6526	9.3576	107	2033	3.3081	9.6495	147	8630	3.9360	10.1032
28	710	2.8514	8.6934	68	416	2.6187	9.3674	108	2127	3.3278	9.6560	148	8962	3.9524	10.1251
29	726	2.8610	8.7224	69	381	2.5805	9.3769	109	2223	3.3469	9.6627	149	9312	3.9690	10.1481
30	741	2.8698	8.7502	70	344	2.5363	9.3862	110	2321	3.3656	9.6694	150	9681	3.9860	10.1720
31	755	2.8779	8.7770	71	306	2.4857	9.3954	111	2421	3.3840	9.6763	151	10072	4.0031	10.1970
32	763	2.8853	8.8030	72	267	2.4258	9.4044	112	2523	3.4019	9.6831	152	10491	4.0208	10.2231
33	780	2.8920	8.8280	73	226	2.3537	9.4132	113	2627	3.4195	9.6901	153	10940	4.0390	10.2504
34	791	2.8980	8.8521	74	184	2.2639	9.4218	114	2734	3.4368	9.6972	154	11415	4.0575	10.2792
35	801	2.9034	8.8755	75	140	2.1458	9.4303	115	2843	3.4538	9.7044	155	11929	4.0766	10.3094
36	809	2.9081	8.8980	76	95	1.9767	9.4386	116	2954	3.4704	9.7119	156	12483	4.0963	10.3412
37	817	2.9122	8.9198	77	48	1.6840	9.4468	117	3068	3.4868	9.7195	157	13086	4.1168	10.3746
38	823	2.9156	8.9409	78	+	+	9.4546	118	3184	3.5030	9.7272	158	13740	4.1380	10.4098
39	829	2.9184	8.9614	79	49	1.6910	9.4624	119	3302	3.5188	9.7352	159	14455	4.1600	10.4469
40	833	2.9205	8.9813	80	[illegible]	2.0006	9.4701	120	3423	3.5345	9.7433	160	15223	4.1825	10.4861

USE. In the 1st Column find the *Comet's Longitude* from the Perihelion the same as that given according to the Hypothesis of a *parabolic* Orbit (by *Halley's, De la Caille's, or other Tables*) against which Longitude, in the *3d Column*, you have the Logarithm answering to a Number of Minutes in *2d Column*. From which Logarithm *subtract* the Logarithm of the *greater Axe* divided by the *Perihelion Distance* of the Comet's elliptic Orbit, and the *Remainder* will be the Logarithm of a Number of Minutes to be added or subtracted to or from the said Longitude, as the *Table* above directs, for the *Comet's* true Longitude in the *elliptic Orbit*.

Likewise, from the Logarithm in the *4th Column*, correspondent to the said Longitude, subtract the Logarithm of the said *Quotient*, and the Remainder, connected with $\overline{10}$ as *Index*, will be the Logarithm of a *Quantity* to be deducted, from the Logarithm of the Comet's Distance from the Sun, in the *parabolic Hypothesis*, for the Logarithm of the *Comet's* Distance from the SUN, according to the *elliptic Orbit*.

EXAMPLE. Let *the greater Axe of the Ellipsis be* = 35,727, *and Perihelion Distance* = 0,5825 (*being the Orbit of the Comet seen in the Year* 1682) *and let the* Longitude *from Perihelion according to the parabolic Orbit, in Dr.* Halley's Table, *be* 44° 3′ 20″, *with the Log.* 0,65838 *of the Comet's Distance from the Sun, correspondent.*

The Log. of $\frac{35.727}{0.5825}$ = 1.7877 — . . . 1.7877 —
2.9228 in Tab. . . 9.0555 against 44° Longitude.

Subtract 13′ 39″ = 13′,65 . . 1.1351 Log. 7.2678
Com à Perih. 44° 3 20 in par. Orb.
— $\overline{10}$

Rem. Long. 43 49 41 from Perih. req. in ellip. Orb.

Or Log. $\overline{3}$.2678 . . No. corresp. [illegible] —
Log. Com. à ☉ in parab. Orb. [illegible]

Log. of Comet's Distance from the Sun, required . . [illegible] Rem. in ellipt. Orb.

☞ The foregoing Table not only reduces the Comet's Longitude from a *parabolic* to an elliptic Orbit, by the Difference of Motion in these two Orbits, but is farther useful, for *nearly* determining the *Species* of the elliptic Orbit which a *new Comet* describes, when the Observations made thereon differ essentially from the computed Places by the parabolic *Hypothesis*.

COMPUTATION

COMPUTATION of an OPPOSITION of the SUN and MOON, (with their Places.) By D. COWPER.

D. COWPER, obferving the Difference *(in P. 397)* between the Time of the Ecliptic *Oppofition* of the *Sun* and *Moon*, computed by a *few* Equations, and the Time computed in M. *De la Caille*'s *Ephemerides*, has computed (from all the *lunar Equations*, marked C.) the Time more *correctly* as follows, on *March* 17^d 12^h 3^m 36^s, in 1764, for *Greenwich*, D. C.
By *De la Caille*'s Ephemerides 2 16 . . . for *Greenwich*.

1 20 Diff.

For, 1764, *March* 17^d 11^h 53^m, mean Time, Sun's true Place ♓ 27° 53′ 58″
Moon's true Ecliptic Place at *that* Time 5 27 47 46

☽ à ☉ *fhort* of an *Oppofition* . . . 6 12
☉ à ☽ *paft* an *Oppofition* in Hour after . . . 28 53

Mot. ☽ à ☉ in an Hour. the *Sum* . . . 35 5

Now, 35′ 5″ : 60^m :: 6′ 12″ : 10^m 36^s to be added to the firft Time, for Time of true Oppofition.
March 17^d 11^h 53 0

1764, *March* 17 12 3 36 Mean Time of the true Oppofition of the Sun and Moon, at *Greenwich*, D. C.

Moon's Lat. N. D. 0° 39′ 1″ }
Horizontal Parallax 60 31 } M. Anom. ☉ 8^s 17° 11′ 23″ in 1764 *March* 17^d 11^h 53^m.

According to *Mayer*'s Tables 1764, *March* 17^d 12^h 2^m . . Sun's Longitude . . 11^s 27° 53′ 58″
Moon's Ecliptic Longitude at that Time . . 5 27 47 21

☽ à ☉ fhort of Oppofition . . 6 37

Now, As 35′ 5″ hourly Mot. ☽ à ☉ : 60^m :: 6′ 37″ fhort of Oppofition : 11^m 19^s
March 17^d 12^h 2 0

Oppofition according to *Mayer* . . 1764, *March* 17 12 13 19 for *Paris*.
M. *De la Caille* 17 12 11 36 for *Paris*.

Moon's Lat. N. D. 0° 39′ 20″ }
Horizontal Parallax 60 57 } 1 43 Diff.

Correfpondent to 1764, *Mar.* 17^d 3^m 59^s *Mayer*, and *Mar.* 17^d 2^m 16^s *De la Caille*, for *Greenwich*.

According to D. C.
1737, *February* 18^d 2^h 37^m 53^s Mean Time, Moon's Place computed in *Syzygy* ♓ 11° 7′ 39″
Obferved . . . ♓ 11 11 23
} By our *fupplemental* Equations, *doubling* 6th Equation = − 4′ 50″.

Moon's Lat. N. 0° 37′ 57″
Error − 4 44
+ 2 25 for 6th Equation, *fingle*.

Error but − 2 19

The fame *computed* by all the Moon's Equations C. *(connecting* the Correction of 6th and 7th Equations + 56″)
♓ 11 11 23 the fame as obferved.

☞ D. Cowper *is doubtful whether the* Acceleration *of the Moon's mean Motion in this Century be a Correction or not, for Want of fufficient Obfervations. Who is of Opinion the Theory of Gravity requires, that the* Apogeon *and* Node *fhould be accelerated* too; *but not in the* Ratio *as is given by Mr.* Gael Morris, (in the *Aftronomia Arcana*, or *Greenwich* Tables, he has fecretly printed) *but in the* Ratio *of the* annual *Equations to each other, as* 6, 10, *and* 5, *very nearly*; *in which* Proportion *the Correction of the Moon's mean Motion is given in the foregoing Computation.*

CONCLUSION, or LAND.

*** *The* Plan *of our* WORK *being already far extended beyond its* original defigned Limits, *our Reader, it is hoped, will excufe us, for omitting the general* geometrical Conftruction *of* SOLAR ECLIPSES, &c. *to make Room for the foregoing* METHOD *of computing the* LONGITUDE OF PLACES BY OBSERVATION OF THE MOON, *and other more neceffary Subjects.*

What we have farther promifed, *and is expected from us, to complete our* WORK, *we refer the* Readers *for Satisfaction, to our* Aftronomia Perfecta, *or* SUPPLEMENTAL ASTRONOMER, and NAVIGATOR, (partly finifhed) *to be publifhed by* Subfcription, *at Half a Guinea paid down for each complete Book, in Sheets, as foon as we find fufficient* Encouragement: *Works of this Nature having* too few *Readers, and are too expenfive to be publifhed* otherwife; *as we have already fufficiently experienced.*

The Number of our Subfcribers to this *prefent Work* are *fo few*, that we think it rather a Diminution than a Reputation to Science to print fo *fmall a Lift*. But we the lefs wonder at fo few Encouragers of Science, as there have been fo many *Impofitions*, by Men taking Subfcribers Money for *Books*, or *engraved Performances*, they were never qualified to execute, nor defigned to deliver. Who therefore ought to be looked upon as Enemies to *Science*, *Society*, and their *Country*. And we are forry to fay that fome Perfons (who would be thought very honeft) have *traded* with our Subfcribers Money for Want of a Principle and Spirit to pay it, as they were ordered, for our Ufe, in carrying on this *expenfive Work*: The *original Plan* of which being augmented from 30 to $53\frac{1}{2}$ Sheets, in *Quarto*.

F I N I S.